

A Survey of Freshwater Mussel Aggregations on the Lower Black River, Wisconsin.

By

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CONVERSION FACTORS

Multiply	By	To obtain
Foot (ft)	3.048×10^{-1}	meter
Mile (mi)	1.609×10^0	kilometer
Square mile (mi ²)	2.590×10^0	square kilometer
Cubic foot (ft ³)	2.832×10^{-2}	cubic meter
Cubic foot per second (cfs)	2.832×10^{-2}	cubic meter per second
Ton (short)	9.072×10^{-1}	megagram or metric ton

INTRODUCTION

This report summarizes the 2001 to 2002 results of a survey of freshwater mussel aggregations on the lower Black River in western Wisconsin. The purpose of this survey was to inventory and describe potential locations for introduction of the federally endangered higgins' eye freshwater mussel (*Lampsilis higginsii*). This effort was part of mussel propagation efforts related to the continued operation and maintenance of the Mississippi River System Navigation project by the U. S. Army Corps of Engineers in cooperation with the associated, multi-agency Mussel Coordination Team.

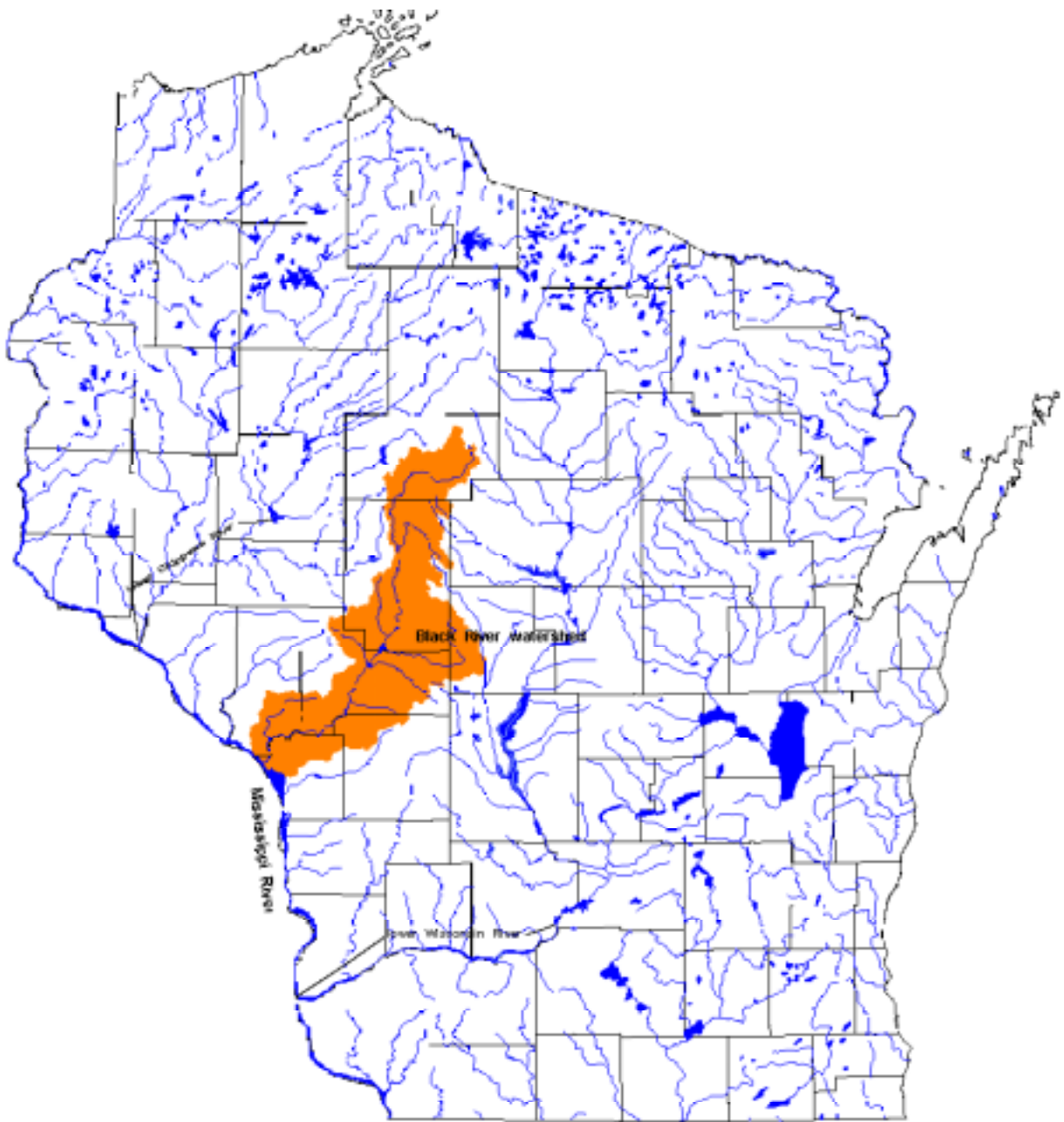
The lower Black River was chosen, along with other upper Midwestern rivers, for potential *L. higginsii* introduction or re-introduction due to its geographic location, size, mussel community composition and its relatively low risk level for zebra mussel (*Dreissena polymorpha*) colonization.

The questions we wanted answered were 1) Where are the potential mussel aggregations located? 2) Where are known mussel aggregations located? 3) What is the quality and community composition within the known mussel aggregations? 4) Which of the known mussel aggregations is of the highest quality and which ones could potentially support *L. higginsii*?

STUDY AREA

The Black River is a 198 mile-long stream located in west central Wisconsin (Figure 1). It has a drainage basin of 2574 mi² and empties directly into the Mississippi River near the City of La Crosse, Wisconsin. It descends from its headwaters to the dam at Black River Falls (river mile 62.4) an average of 6.6 ft/mi. Downstream of this dam, it descends towards the Mississippi River an average of approximately 1.7 ft/mi. Rock substrates, derived from Precambrian crystalline bedrock, are present from Black River Falls upstream 40 miles. Sandy substrates, derived from Cambrian sandstones, dominate the streambed from Black River Falls downstream to the confluence with the Mississippi River. These sandstones and eroded sands contribute to a large bedload in the stream. The total annual sediment load estimated from measurements taken at the at the downstream-most gage located near Galesville, Wisconsin at river mile 14.1 (USGS 05382000)

Figure 1. Black River Basin in Wisconsin.



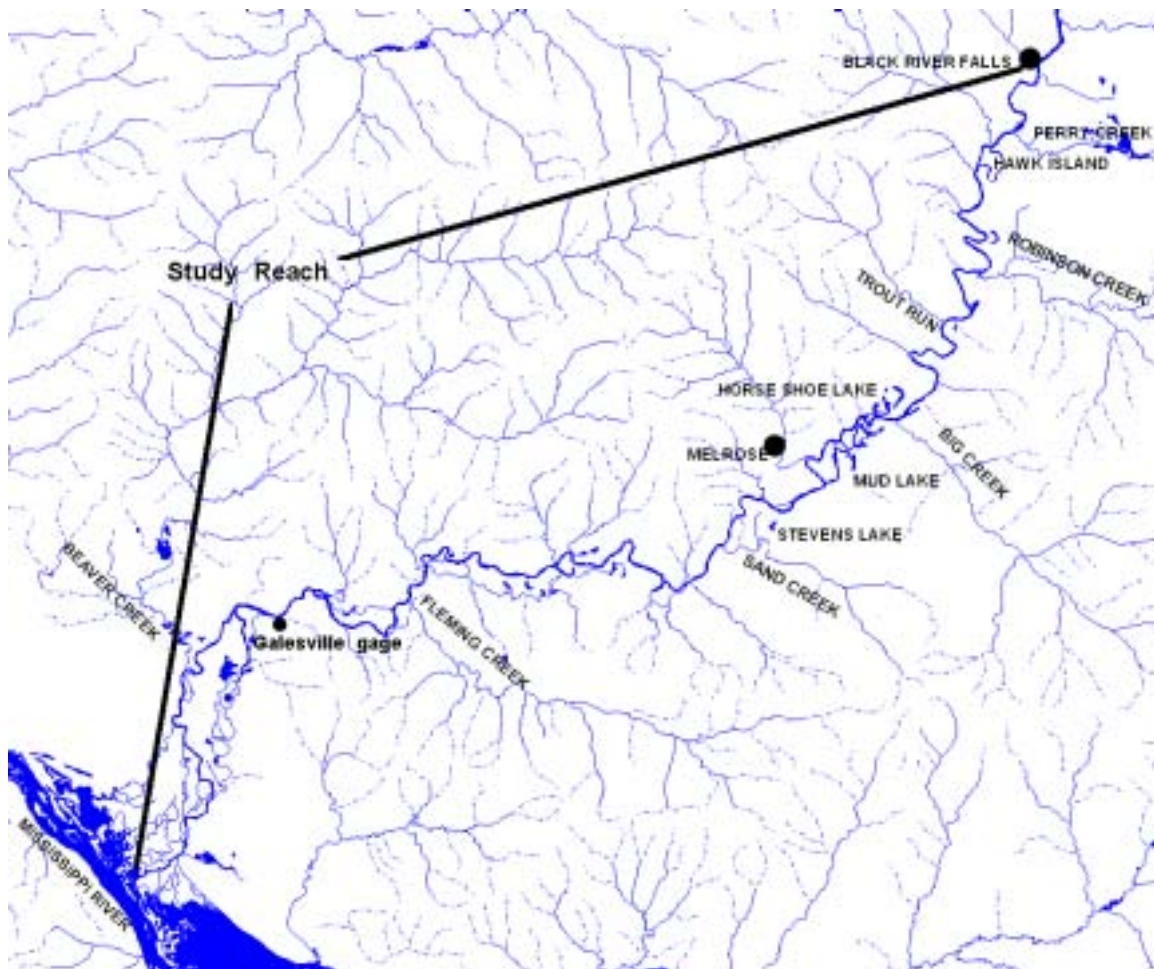
ranged from 42,300 to 471,000 tons and averaged 277,000 tons during the water years 1974-1983 (Rose, 1992).

The mean daily flow is 1788 cubic feet per second (cfs) for the 1931-2003 period of record. The maximum and minimum flows recorded are 62,000 and 180 cfs, respectively.

METHODS AND MATERIALS

We conducted this mussel aggregation survey on the lower 62.4 miles of the Black River from the dam at the City of Black River Falls downstream to its confluence with the Mississippi River (Figure 2). We began by first reviewing all mussel information previously collected from this reach. Based on previous mussel-related work on the lower Black River and other similar rivers in the upper Midwest, we assumed that nearly all mussel aggregations were associated with gravel or rock bars and that very few mussels are found in shifting sand, which is the dominant substrate type in this reach.

Figure 2. Reach of Black River Studied in 2001 and 2002.



Then, during the summers of 2001 and 2002, we reconnoitered the river using an outboard engine-powered canoe and airboat to locate and map gravel and rock bars as

well as visible mussel aggregations. We located and mapped these either visually or using a 10 ft-long pole that was probed into the substrate. Bars and aggregations were recorded using a Lowrance Globalnav ® 212 Geographic Positioning System receiver as well as United States Geological Survey 7.5 Minute Series Topographic maps and aerial photographs from various sources. Approximate widths, lengths and general substrate characteristics were taken at each bar and mussel aggregation.

Bars and preliminarily identified mussel aggregations found during the reconnaissance survey were prioritized for future detailed examination based on the potential for a mussel aggregation. The potential existence of a mussel aggregation was based on the size of the bar, its' substrate characteristics and presence or absence of mussels or mussel shells.

Detailed examinations included sampling mussels using SCUBA divers. Two divers both visually and tactilely characterized substrates in a portion of, or throughout the entire previously identified bar or aggregation. Most locations examined were sampled for at least 5 minutes during which we collected all living and dead mussels encountered. We defined a mussel aggregation as a location where we found at least five living mussels in one hour of collecting. All mussels encountered both living and dead, were brought to the surface, identified and counted. We did not measure mussel population density, but at most locations examined, we visually estimated this density.

RESULTS AND DISCUSSION

Previous Mussel Work

A number of surveys limited in scope and extent have been done on the lower Black River, but no comprehensive survey has ever been done. During 1976, Mathiak (1979) examined 5 locations and found about 27 individuals representing 8 species (Table 1). From 1981-1997, various collectors, including Heath (Unpub), Wisconsin Department of Natural Resources (Unpub.) and Havlik (Ohio State University Museum of Biological Diversity collections) recorded 200 living individuals representing 15 species and 3 additional species represented by dead individuals. No living or dead *L. higginsii* were recorded from any of these investigations.

**Table 1. List of Freshwater Mussel Species
Found in the Lower Black River, Wisconsin.**

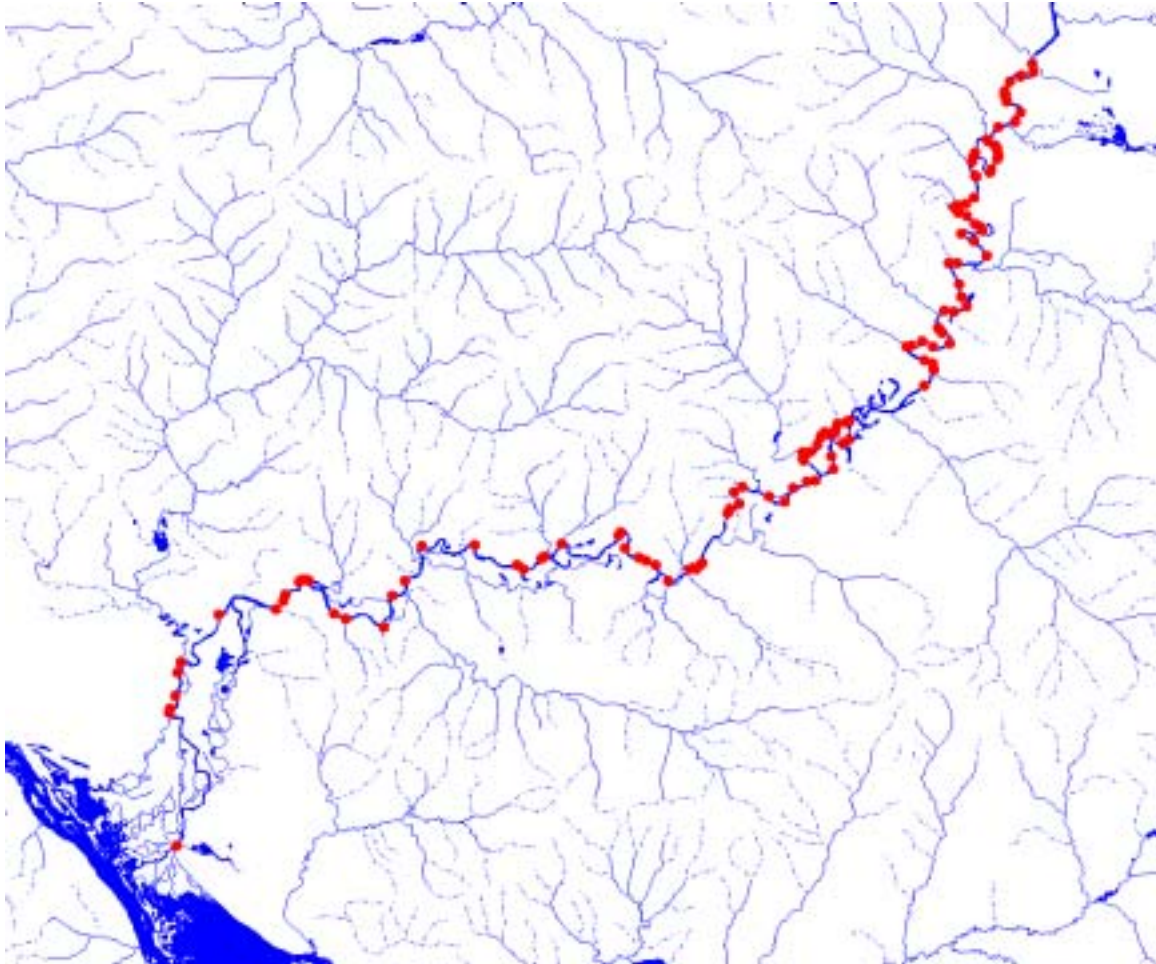
	Mathiak	Misc.	This Study
TAXON	1976	1981-1996	2001-2002
<i>Actinonaias ligamentina carinata</i>		L	L
<i>Alasmidonta marginata</i>		L	L
<i>Amblema plicata plicata</i>		L	L
<i>Anodonta grandis form corpulenta</i>	L	L	L
<i>Anodonta suborbiculata</i>			D
<i>Ellipsaria lineolata</i>			L
<i>Fusconaia flava</i>	L	L	L
<i>Lampsilis siliquoidea</i>	L	L	L
<i>Lampsilis cardium</i>	L	L	L
<i>Lasmigona complanata complanata</i>	L	L	L
<i>Lasmigona compressa</i>			L
<i>Lasmigona costata</i>		D	L
<i>Leptodea fragilis</i>	L	L	L
<i>Ligumia recta</i>		L	L
<i>Pleurobema sintoxia</i>		L	L
<i>Potamilus alatus</i>	L	L	L
<i>Quadrula metanevra</i>		D	
<i>Quadrula pustulosa pustulosa</i>		D	L
<i>Quadrula quadrula</i>			L
<i>Simpsonaias ambigua</i>			L
<i>Strophitus undulatus undulatus</i>		L	L
<i>Toxolasma parvus</i>			L
<i>Tritogonia verrucosa</i>	L	L	L
<i>Truncilla donaciformis</i>			L
<i>Truncilla truncata</i>		L	L
TOTAL INDIVIDUALS	27	200	1536
TOTAL SPECIES REPRESENTED LIVING	8	15	23
ADDITIONAL SPECIES REPRESENTED DEAD	0	3	1

Reconnaissance Survey of Gravel and Rock Bars

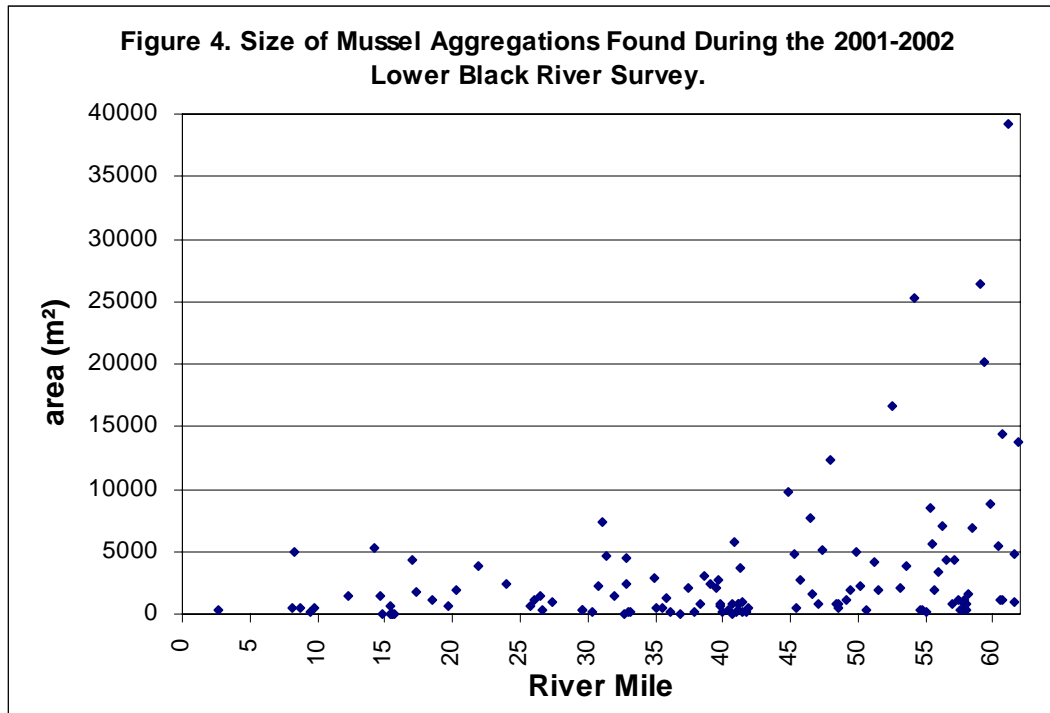
A total of 125 gravel bars, rock bars or mussel aggregations were found during the reconnaissance survey. These locations are shown in Figure 3. Over half of these 125 bars were located in the upstream one-third of the study reach. This is consistent with the geology of the lower Black River. There are decreasing remnants of the crystalline

bedrock and increasing volumes of unconsolidated sand the farther one is downstream from Black River Falls.

Figure 3. Location of 125 Gravel Bars and Rock Bars Found During the 2001-2002 Lower Black River Reconnaissance Survey.



Not only were most bars located in the upstream reach, total area of bars was distributed differently from upstream to downstream. The upstream one-third of the study reach accounted for 77.7% of the total bar surface area of 39.38 ha. The average size of bars increased from downstream to upstream. Near the mouth, the average bar size was close to 1500m², at river mile 30 the average size was about 1100m² while near Black River Falls at mile 62, the mean size was about 11000m² (Figure 4). The total surface area of bars (38.38 ha) covered 4% of the total instream surface area of 962.7 ha.



A total of 71 of the 125 bars were examined in detail. Of the priority 1 locations, 19 of the 20 were examined in detail. A total of 40 of the 50 priority 2 and 12 of the 55 priority 3 locations were examined (Table 2).

Mussel Aggregations

Of the 71 bars that were examined in detail, 49 (69%) were mussel aggregations based primarily on finding an average of greater than five mussels per hour of searching (Table 2).

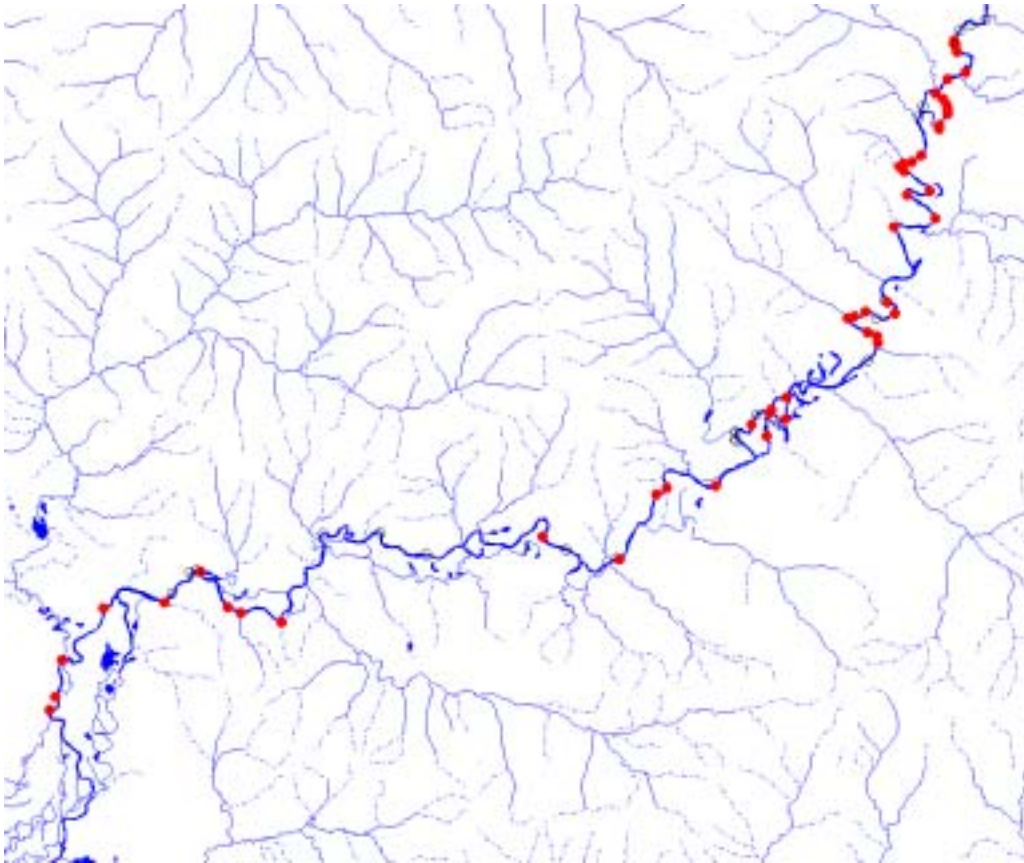
The distribution of mussel aggregations had a similar spatial pattern as gravel bars. A total of 60.3% of the aggregations were in the upstream one-third of the study reach. The upstream one-third of the study reach accounted for 84% of the total mussel aggregation surface area of 22.7 ha². The average size of aggregations generally increased from downstream to upstream. Near the mouth, the average bar size was 2226m², at river mile 30 the average size was about 1537m² while near Black River Falls at mile 62, the mean size was about 12299m².

Table 2. List of Gravel and Rock Bars, Rivermile, Survey Priority, Detailed Examination Status, Bed Status, Catch Per Hour and Total Surface Area. Lower Black River, 2001-2002.

MAP_CODE	RIVERMI	PRIORITY	EXAMINED	BED	CPH	AREA (m ²)
CG	2.66	3	n			373
CF2	8.11	3	n			404
CF1	8.24	3	y	y	62.61	4938
CE	8.75	2	y	y	12.86	558
CD2	9.49	3	n			184
CD1	9.80	3	y	y	88.24	457
CC	12.29	1	y	y	39.72	1440
CB	14.20	2	y	y	48.00	5283
CA2	14.58	3	y	n	5.45	1414
CA1	14.76	3	n			71
BZ6	15.37	2	y	n		710
BZ5	15.44	2	n			51
BZ4	15.50	2	n			64
BZ3	15.55	2	y	n	2.40	69
BZ2	15.61	2	n			40
BZ1	15.64	2	y	y	24.00	35
BY	16.99	1	y	y	11.20	4297
BX	17.37	1	y	y	90.40	1699
BW	18.48	1	y	y	6.67	1157
BV	19.62	3	n			638
BU	20.34	3	n			1988
BT	21.85	2	y	n		3791
BS	23.99	3	y	n		2322
BR	25.76	3	y	n		607
BQ	25.98	3	n			1112
BP2	26.52	3	n			1435
BP1	26.66	3	n			244
BO	27.37	3	n			938
BN2	29.55	3	n			352
BN1	29.64	3	n			297
BM	30.30	2	y	y	8.57	162
BL	30.82	3	n			2208
BK2	31.07	2	y	n	5.00	7311
BK1	31.37	3	n			4624
BJ	32.00	3	n			1515
BI	32.74	3	n			35
CT	32.91	3	y	y	16.55	2461
BH	32.92	2	y	n	0.00	4475
BG2	33.06	3	n			165
BG1	33.14	3	n			174
BF	34.96	3	n			2841
BE	35.08	2	y	y	13.33	496
CW	35.47	2	y	y		490
BD2	35.80	3	n			1304
BD1	36.09	3	n			108
BC	36.91	3	n			46
BB	37.40	1	y	y	112.26	2005
BA	37.87	3	n			86
AZ	38.31	2	n			754
AY	38.60	3	n			3012
CR	39.11	3	n			2326
AX	39.50	2	y	n		2146
AW	39.59	2	y	n	0.00	2728
CQ	39.74	2	y	y	38.18	610
AV	39.76	2	y	n	0.00	860
AU	40.02	3	n			82
AT	40.42	2	y	y	14.91	363
AS3	40.64	3	n			48
AS2	40.71	2	y	n		724
AS1	40.85	3	n			5718
AR2	40.99	2	n			162
AR1	41.10	2	y	y	7.14	773
CU	41.15	2	y	n		873

MAP_CODE	RIVERMI	PRIORITY	EXAMINED	BED	CPH	AREA (m ²)
CV	41.16	2	y	y	5.00	298
AQ	41.27	2	y	y	20.40	3750
AP	41.45	3	n			960
AO3	41.50	2	n			142
AO2	41.75	2	n			206
AO1	41.82	3	y	y	25.38	508
AN	44.78	2	y	n		9789
AM	45.32	2	y	y	7.50	4765
AL	45.49	3	n	y		511
AK	45.77	3	y	y		2711
AJ	46.45	3	y	y	14.12	7739
AI	46.67	2	y	y	40.00	1571
AH	47.05	2	y	y	41.74	827
AG	47.40	2	y	n	10.00	5143
AF	47.92	2	y	y	31.76	12508
AE3	48.46	2	y	y	3.25	805
AE2	48.54	2	y	n	0.00	821
AE1	48.57	2	n			526
AD	49.14	3	n			1088
AC	49.37	3	n			1885
AB	49.85	3	n			4983
AA	50.18	3	n			2283
Z	50.57	3	n			276
Y	51.27	2	y	y	12.44	4217
X	51.53	3	n			1919
W	52.50	1	y	y	0.00	16619
V	53.10	2	n			2143
CP	53.50	2	y	y		3806
U	54.21	1	y	y	46.00	25266
T2	54.60	3	n			364
T1	54.72	3	n			349
S	55.08	3	n			163
R2	55.38	2	y	y	27.50	8555
R1	55.50	2	y	y	12.31	5601
Q	55.70	2	y	y	30.00	1914
P	55.90	2	y	y	120.00	3355
O	56.19	2	y	y	66.32	7110
L	56.48	3	y	n	2.00	4398
N	57.02	3	n			736
M	57.17	3	n			4295
CI	57.42	1	y	y	44.00	1067
CJ	57.52	1	y	y	22.50	363
K	57.64	3	n			349
J	57.80	3	y	n	3.33	1199
CK	57.92	1	y	y	8.18	453
CL	57.93	1	y	y	60.00	775
CM	58.01	1	y	y	154.67	878
CN	58.07	1	y			367
CO	58.09	3	y	y	19.33	1548
I	58.45	2	y	y	9.43	6827
H2	58.97	2	y	y	7.59	26426
H1	59.38	2	y	y		20157
G	59.84	2	n			8812
F3	60.30	1	y	y	55.38	5396
F2	60.58	2	y	n		1112
F1	60.62	1	y	y	42.00	1094
E2	60.72	1	y	y	10.71	14347
E1	61.08	1	y	n	1.58	39221
C	61.49	1	y	n	0.00	4759
D	61.49	1	n			997
B	61.90	1	y	n	24.00	13708
A	62.17	3	n			638

Figure 6. Location of Mussel Aggregations Found During the 2001-2002 Lower Black River. ● = Known Mussel Aggregation Locations. ○ = Examined & Not an Aggregation.



In locations determined to be aggregations, the mean catch of living mussels per hour (CPH) was 34.8 (maximum = 154.7, minimum = 0.0). This is probably quite low compared to other local large rivers. Locations of aggregations are given in Figure 6.

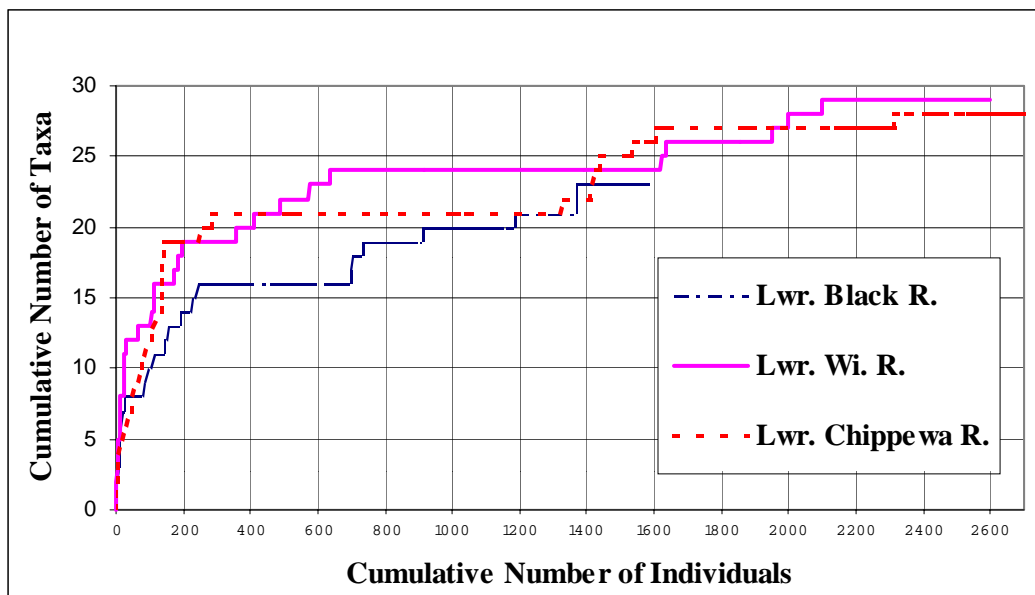
Although there were more and larger bars in the upstream part of the study reach, the CPH for all bars (including mussel aggregations and non-aggregations) was similar throughout the study reach. There was not an upstream-downstream trend observed for CPH. The mean CPH for all bars was 27.8 (maximum = 154.7, minimum = 0.0) (Table 2). Also, there was no upstream-downstream trend in CPH apparent for bars that were aggregations and bars that were not. This suggests that there was no general longitudinal pattern of mussel density throughout the study reach within bars and aggregations.

Species Richness

During this survey, a total of 23 species were represented among 1536 living individuals (Table 1). One additional species was represented by a dead individual only (*Anodonta suborbiculata*). We found every species that has been recorded from the river prior to 2001 except for a subfossil empty shell of *Quadrula metanevra* found by Heath (Unpub.) during 1991. No specimens of *L. higginsii* were found.

Species richness for the lower Black River was slightly lower than other large Mississippi River tributaries in Wisconsin. The lower Wisconsin River (see Figure 1), which contains *L. higginsii*, has about 29 species while the lower Chippewa River has 28 (Figure 5). However, for similar sample sizes (about 1600 individuals), species richness

Figure 5. Species Richness for Lower Black, Wisconsin and Chippewa Rivers.



was about the same among the three rivers. The lower Black River contained 23 species, while the lower Chippewa had 26 and the lower Wisconsin River 24. Additional sampling on the lower Black River may provide a very small number of additional species

We analyzed species associates of *L. higginsii* over a broad geographic scale in the upper Midwest. Several mussels were associated with this species in particular river reaches and some were weakly associated or mutually exclusive. Results of this analysis are given in Table 3.

Table 3. Species Associates of *Lampsilis higginsii*.

Strongly Associated	Moderately Associated	Weakly or Never Associated
<i>Arcidens confragosus</i>	<i>Tritogonia verrusoca</i>	<i>Alasmidonta viridis</i>
<i>Ellipsaria lineolata</i>	<i>Obovaria olivaria</i>	<i>Anodonta cataracta</i>
<i>Elliptio crassidens crassiden</i>	<i>Truncilla truncata</i>	<i>Anodontoides ferusscianus</i>
<i>Fusconaia ebena</i>		<i>Lasmigona compressa</i> (occasionally found with <i>L.h.</i>)
<i>Lampsilis teres form anodontoides</i>		<i>Lasmigona costata</i> (occasionally found with <i>L.h.</i>)
<i>Lampsilis teres form teres</i>		<i>Venustaconcha e. ellipsiformis</i> (rarely found with <i>L.h.</i>)
<i>Megaloniaias nervosa</i>		<i>Villosa i. iris</i>
<i>Potamilus ohioensis</i>		
<i>Quadrula metanevra</i>		
<i>Quadrula nodulata</i>		
<i>Truncilla donaciformis</i>		

A total of 11 taxa are strongly associated with *L. higginsii*. Of these, only two taxa (*E. lineolata* and *T. donaciformis*) were present on the lower Black River. On the lower Wisconsin River and the Mississippi River, where *L. higginsii* is present, 9 of these 11 and all 11 associates are present, respectively. A total of 2 of the 3 moderate associates are present in the lower Black River while all 3 are present in the lower Wisconsin River and Mississippi River. Of the weakly associated or mutually exclusive taxa, 2 of the 7 are present in the lower Black River while three are present in the lower Wisconsin River and none in the Mississippi River. This comparison suggests that the lower Black River may not contain a mussel community that is associated with the presence of *L. higginsii*.

Relative Abundance and Species Distribution Patterns

The fauna was dominated by the lithophilic *Simpsonaias ambigua* which accounted for 17% of the sample (Table 5). It was followed by *Lampsilis cardium* and *Tritogonia verrucosa*. Only single specimens each were found of *Ellipsaria lineolata*, *Truncilla donaciformis*, *Lasmigona compressa*, *Quadrula p. pustulosa* and *Q. quadrula*. All but 7 of the 23 species were found throughout the study reach.

Three of the twenty-three species found were seen predominately in the upstream half of the study reach and were very rare or absent from the downstream half. These were *Lasmigona costata*, *Alasmidonta marginata*, *Strophitus u. undulatus*,

Four species were found only in the downstream half. These were *Truncilla donaciformis*, *Toxolasma parvus*, *Quadrula quadrula* and *Ellipsaria lineolata*.

Table 5. Number of Living and Dead Mussels Found, Relative Abundance, Lower Black River, 2001-2002.

OBS	TAXON	LIVING	DEAD	RANK	% REL. ABUNDANCE
1	<i>Actinonaias ligamentina carinata</i>	20	19	12	1.3
2	<i>Alasmidonta marginata</i>	15	4	13	1.0
3	<i>Amblema plicata plicata</i>	2	3	18	0.1
4	<i>Anodonta grandis form corpulenta</i>	119	58	7	7.7
5	<i>Anodonta suborbiculata</i>	0	1		0.0
6	<i>Ellipsaria lineolata</i>	1	0	19	0.1
7	<i>Fusconaia flava</i>	121	363	6	7.9
9	<i>Lampsilis cardium</i>	170	188	2	11.1
8	<i>Lampsilis siliquoidea</i>	101	111	9	6.6
10	<i>Lasmigona complanata complanata</i>	158	47	4	10.3
11	<i>Lasmigona compressa</i>	1	2	19	0.1
12	<i>Lasmigona costata</i>	13	7	14	0.8
13	<i>Leptodea fragilis</i>	143	101	5	9.3
14	<i>Ligumia recta</i>	70	40	10	4.6
15	<i>Pleurobema sintoxia</i>	107	133	8	7.0
16	<i>Potamilus alatus</i>	46	10	11	3.0
17	<i>Quadrula pustulosa pustulosa</i>	1	1	19	0.1
18	<i>Quadrula quadrula</i>	1	0	19	0.1
19	<i>Simpsonaias ambigua</i>	260	29	1	16.9
20	<i>Strophitus undulatus undulatus</i>	7	7	16	0.5
21	<i>Toxolasma parvus</i>	4	1	17	0.3
22	<i>Tritogonia verrucosa</i>	167	29	3	10.9
23	<i>Truncilla donaciformis</i>	1	0	19	0.1
24	<i>Truncilla truncata</i>	8	9	15	0.5
25	<i>unidentified</i>	0	1		0.0
	TOTAL	1536	1164		100.0

Suggested Locations for Introduction of *L. higginsii*

We did a rank analysis of locations that *L. higginsii* could be introduced. Mussel aggregations were ranked based on a measure of population density (CPH) and the spatial size of the aggregation. This ranking was dependent upon the following assumptions.

We assumed that *L. higginsii* is most likely to be found in locations with relatively high population densities. Also, locations with relatively high population densities would have a greater chance for a successful introduction and habitation and provide for instream mussel reproduction. Past work on various rivers has suggested that sometimes *L. higginsii* is associated with relatively high total mussel population densities. (Baker, et al. 1994; Miller, and Payne. 1997).

A second assumption was that introductions at locations where the size of the aggregation was relatively large would be more successful than locations that were

smaller. Larger aggregations may have more long term stability, a factor that is probably very important in a stream like the Black River which is dominated by shifting, sandy substrates and large fluctuations in water elevations and discharge. Also, due to the broadcast nature of some introduction methods, for example the release of free-ranging fish infested with glochidia or the use of inoculated host fish confined in open-bottomed cages, the chances of newly dropped juvenile mussels settling on suitable substrate would be greater in a larger aggregation.

The rank analysis is given in Table 4. We did not include species richness in the ranking because of highly variable and often small sample sizes which can influence richness values. The mussel aggregations with the highest combined ranking of CPH and surface area were locations “U”, “O”, “F3”, “CF1”, “P”, “CB” and “AF”. All 7 of these aggregations ranked in the top 20 of CPH or surface area.

Location “U” is a 1023 m-long aggregation located on the left descending bank at river mile 54.2 (Figure 7). It has a surface area of 25266 m² and a width of 8 to 63 m. The substrate here was primarily rubble, followed in composition by gravel and coarse sand. The current during normal low discharges was slow and the maximum depth was 1.3m. We found a total of 13 mussel species here among a total of 46 individuals collected. We found no locations that could be protective of caged fish inoculated with mussel glochidia during high discharges. This suggests that there is some risk of cage disturbance and dislodgment here if mussel introductions or reintroduction were attempted here.

Location “O” is a 245 m-long aggregation located on the left descending bank at river mile 56.19 (Figure 8). It has a surface area of 7110 m² and a width of 14 to 22 m. The substrate here was primarily rubble and gravel. We found a total of 11 mussel species here among a total of 21 individuals collected. We found no locations that could be protective of caged fish inoculated with mussel glochidia during high discharges.

Location F3 is a 936 m-long aggregation located on the right descending bank at river mile 60.3 (Figure 9). It has a surface area of 5396 m² and a width of 4 to 9 m. The substrate here was primarily rubble and gravel. We found a total of 7 mussel species here among a total of 24 individuals collected. We found no locations that could be protective of caged fish inoculated with mussel glochidia during high discharges.

Location “CF1” is a 279 m-long aggregation located on the right descending bank

**Table 4. Ranking of Lower Black River Mussel Aggregations
based on Catch per Hours and Total Surface Area.**

AGGREGA- TION CODE	RIVER MILE	CPH	AREA (m ²)	CPH RANK	AREA RANK	CPH & AREA RANK	RICHNESS	NUMBER LIVING (N)
U	54.2	46.00	25265.508	11	2	1	13	46
O	56.2	66.32	7109.619	6	9	2	11	21
F3	60.3	55.38	5395.501	9	12	3	7	24
CF1	8.2	62.61	4938.225	7	14	3	12	139
P	55.9	120.00	3354.992	2	20	4	6	24
CB	14.2	48.00	5283.068	10	13	5	10	48
AF	47.9	31.76	12508.029	18	6	6	2	9
BB	37.4	112.26	2004.693	3	23	7	9	116
R2	55.4	27.50	8555.125	20	7	8	6	11
BX	17.4	90.40	1699.165	4	25	9	16	339
CM	58.0	154.67	877.528	1	32	10	16	232
AJ	46.5	14.12	7739.354	28	8	11	4	4
E2	60.72	10.71	14346.869	34	5	12	7	25
H2	59.0	7.59	26425.905	39	1	13	6	10
H1	59.38	8.46	20156.597	37	3	13	7	22
AI	46.7	40.00	1570.738	15	26	14	9	14
R1	55.5	12.31	5600.93	32	11	15	7	8
AQ	41.3	20.40	3750.023	24	19	15	6	17
Q	55.7	30.00	1913.993	19	24	15	1	3
F1	60.62	42.00	1093.553	13	30	15	7	24
CI	57.4	44.00	1066.913	12	31	15	6	11
CL	57.9	60.00	774.651	8	35	15	8	15
CC	12.3	39.72	1439.772	16	28	16	5	47
I	58.5	9.43	6827.026	35	10	17	7	11
AH	47.1	41.74	826.691	14	33	18	7	16
Y	51.3	12.44	4216.653	31	17	19	10	36
CT	32.9	16.55	2461.022	26	22	19	2	8
CD1	9.8	88.24	457.265	5	43	19	10	75
BY	17.0	11.20	4297.121	33	16	20		
W	52.5	0.00	16618.98	46	4	21	2	2
CO	58.1	19.33	1548.022	25	27	22		
CQ	39.7	38.18	610.112	17	37	23	4	7
AM	45.3	7.50	4765.071	40	15	24	1	1
AO1	41.8	25.38	508.036	21	40	25	6	14
CP	53.5	0.28	3806.106	45	18	26	11	53
CE	8.8	12.86	557.903	30	38	27	2	3
CJ	57.5	22.50	362.841	23	46	28	1	3
BE	35.1	13.33	495.936	29	41	29	3	6
BW	18.5	6.67	1156.776	42	29	30	3	6
BZ1	15.6	24.00	35.185	22	49	30	1	6
AT	40.4	14.91	363.006	27	45	31	7	41
AR1	41.1	7.14	773.485	41	36	32	7	20
AE3	48.5	3.25	805.216	44	34	33	7	13
CK	57.9	8.18	452.64	38	44	34	3	3
BM	30.3	8.57	161.984	36	48	35	3	5
CV	41.2	5.00	297.827	43	47	36	4	4
AK	45.8		2711.262		21		3	3
AL	45.5		511.291		39			
CW	35.5		490.445		42			

at river mile 8.24 (Figure 10). It has a surface area of 4938 m² and a width of 2 to 27 m. The substrate here was primarily gravel followed by rubble and coarse sand. We found a total of 12 mussel species here among a total of 139 individuals collected. We found no locations that could be protective of caged fish inoculated with mussel glochidia during high discharges.

Location “P” is a 173 m-long aggregation located on the left descending bank at river mile 55.9 (Figure 11). It has a surface area of 3355 m² and a width of 17 to 21 m. The substrate here was primarily gravel and rubble. We found a total of 6 mussel species here among a total of 24 individuals collected. We found no locations that could be protective of caged fish inoculated with mussel glochidia during high discharges.

Location “CB” is a 1286 m-long aggregation containing two disjunct segments located on the left descending bank at river mile 14.2 (Figure 12). It has a surface area of 5283 m² and a width of 3 to 6.5 m. The substrate in the downstream segment, outside of Council Bay, was dominated by equal amounts for boulder and rubble followed by coarse sand. The segment within Council Bay was dominated by fine sand followed by muck and silt. Maximum depth throughout this aggregation was 1 m. There was no perceivable current within Council Bay and a moderate current in portions outside of the bay. We found a total of 10 mussel species here among a total of 48 individuals collected. Council Bay provided an evidently excellent location that could be protective of caged fish inoculated with mussel glochidia during high discharges. Although this bay would not provide suitable habitat for adult *L. higginsii* due to its silty substrate and lack of current, mussels could be reared here until they attained suitable size for outplanting at a more riverine location.

Location “AF” 610 is a 600m-long aggregation located on the left descending bank at river mile 47.9 (Figure 13). It has a surface area of 12508 m² and a width of 45 to 11 m. The substrate here was primarily bedrock in the upstream half with gravel and rubble from shore out 5m. The lower half is a mix of bedrock and gravel and rubble. We found a total of 2 mussel species here among a total of 9 individuals collected. An additional 5 species were found dead along the shoreline. We found no locations that could be protective of caged fish inoculated with mussel glochidia during high discharges.

Figure7. Map of Mussel Aggregation "U".



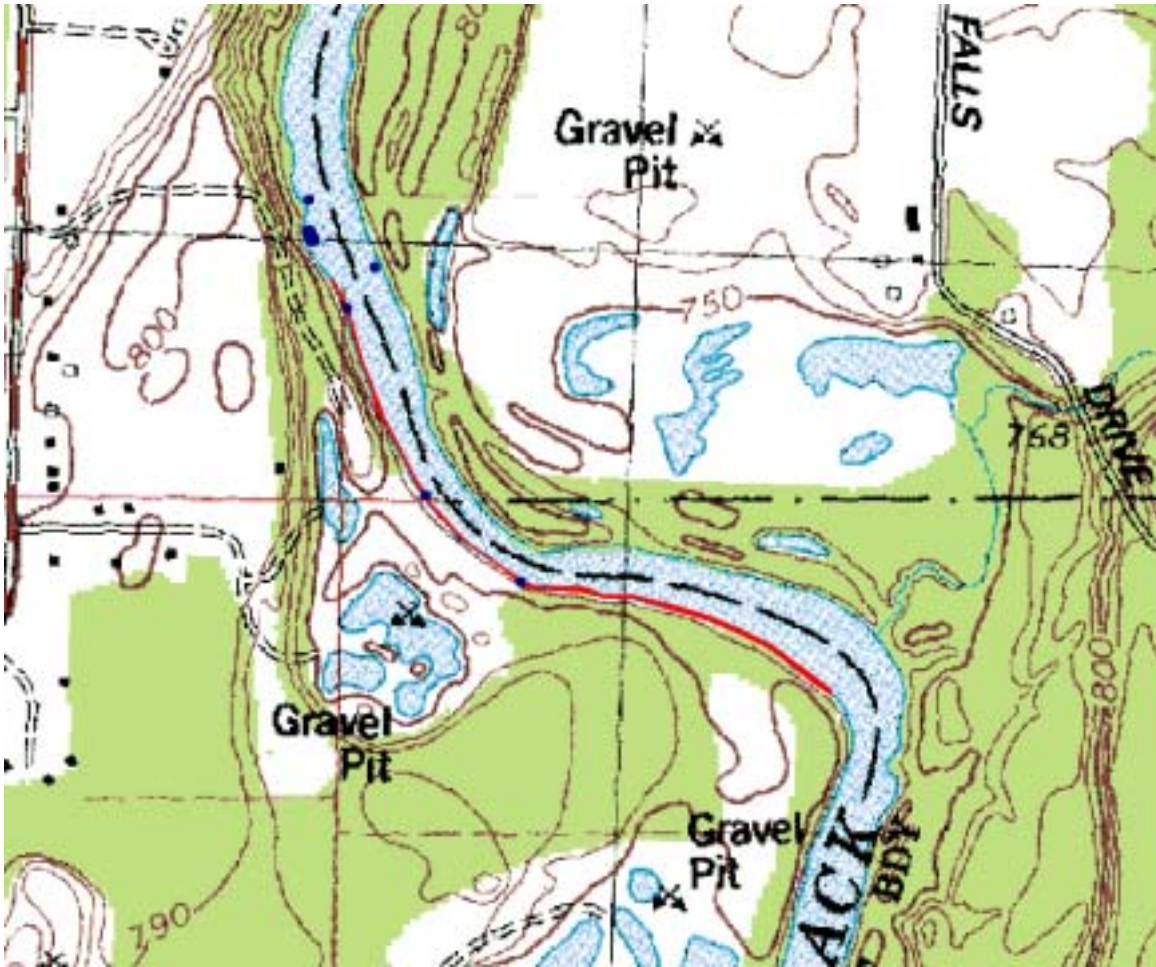
MUSSEL AGGREGATION "U"	
Latitude/Longitude	44° 13' 23.5"N, 90° 52' 28.4"W
Public Land Survey	Twp. 20N, Rng. 4W, Sec. 8 SE ¼, Jackson County, Wisconsin.
River Mile	52.4
Visually Est. Density	2/m ²
Rank	1

Figure 8. Map of Mussel Aggregation "O".



MUSSEL AGGREGATION "O"	
Latitude/Longitude	44° 14' 12.5"N, 90° 52' 46.1"W
Public Land Survey	Twp. 20N, Rng. 4W, Sec. 5 SE ¼, Jackson County, Wisconsin.
River Mile	56.19
Visually Est. Density	1.5/m ²
Rank	2

Figure 9. Map of Mussel Aggregation "F3".



MUSSEL AGGREGATION "F3"	
Latitude/Longitude	44° 16' 38.0"N, 90° 51' 38.2"W
Public Land Survey	Twp. 21N, Rng. 4W, Sec. 22 SW ¼, Twp. 21N, Rng. 4W, Sec. 27 NW ¼, Jackson County, Wisconsin.
River Mile	60.3
Visually Est. Density	1/m ²
Rank	3

Figure 10. Map of Mussel Aggregation "CF1".



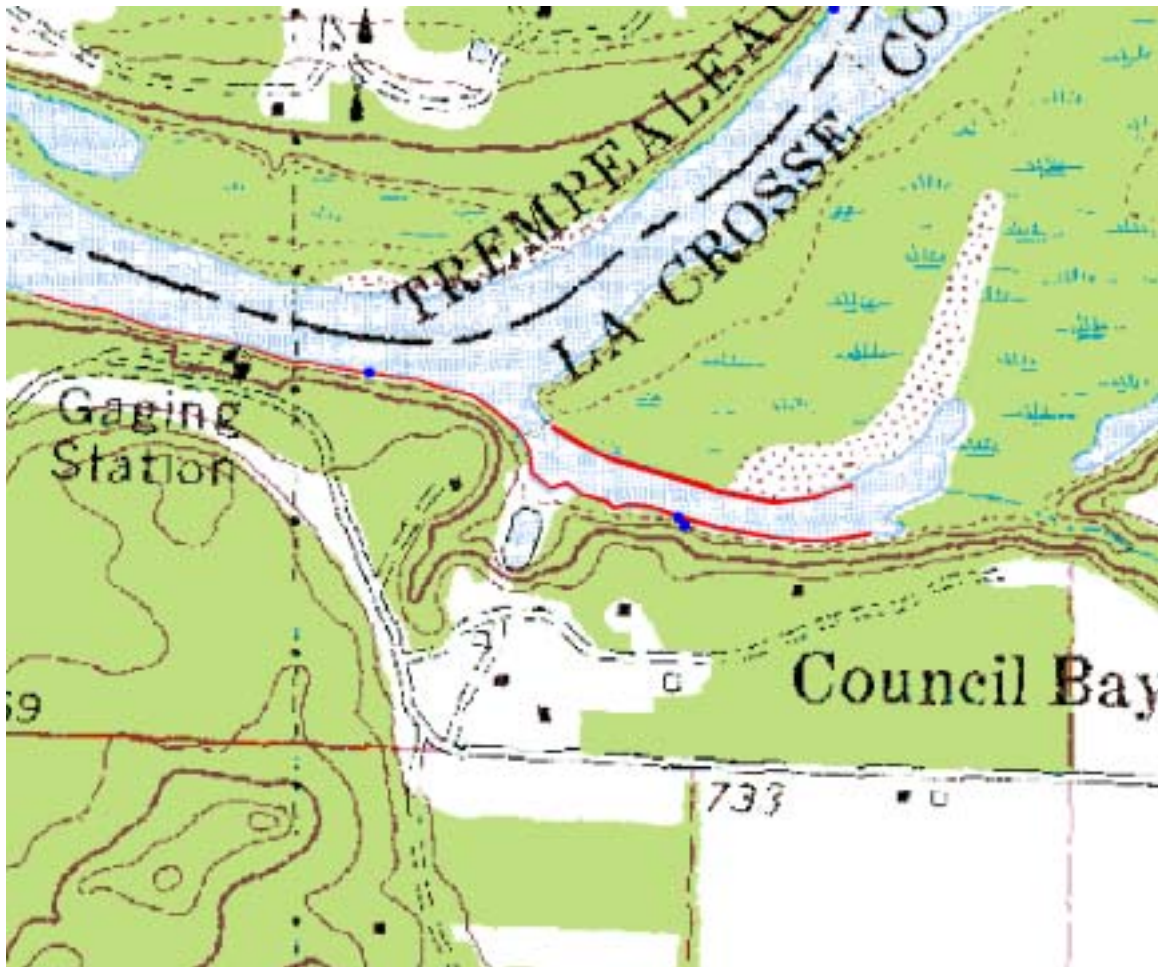
MUSSEL AGGREGATION "CF1"	
Latitude/Longitude	44° 1' 2.6"N, 91° 10' 39.8"W
Public Land Survey	Twp. 18N, Rng. 8W, Sec. 21 SW ¼, Trempealeau County, Wisconsin.
River Mile	8.24
Visually Est. Density	5/m ²
Rank	3

Figure 11. Map of Mussel Aggregation "P".



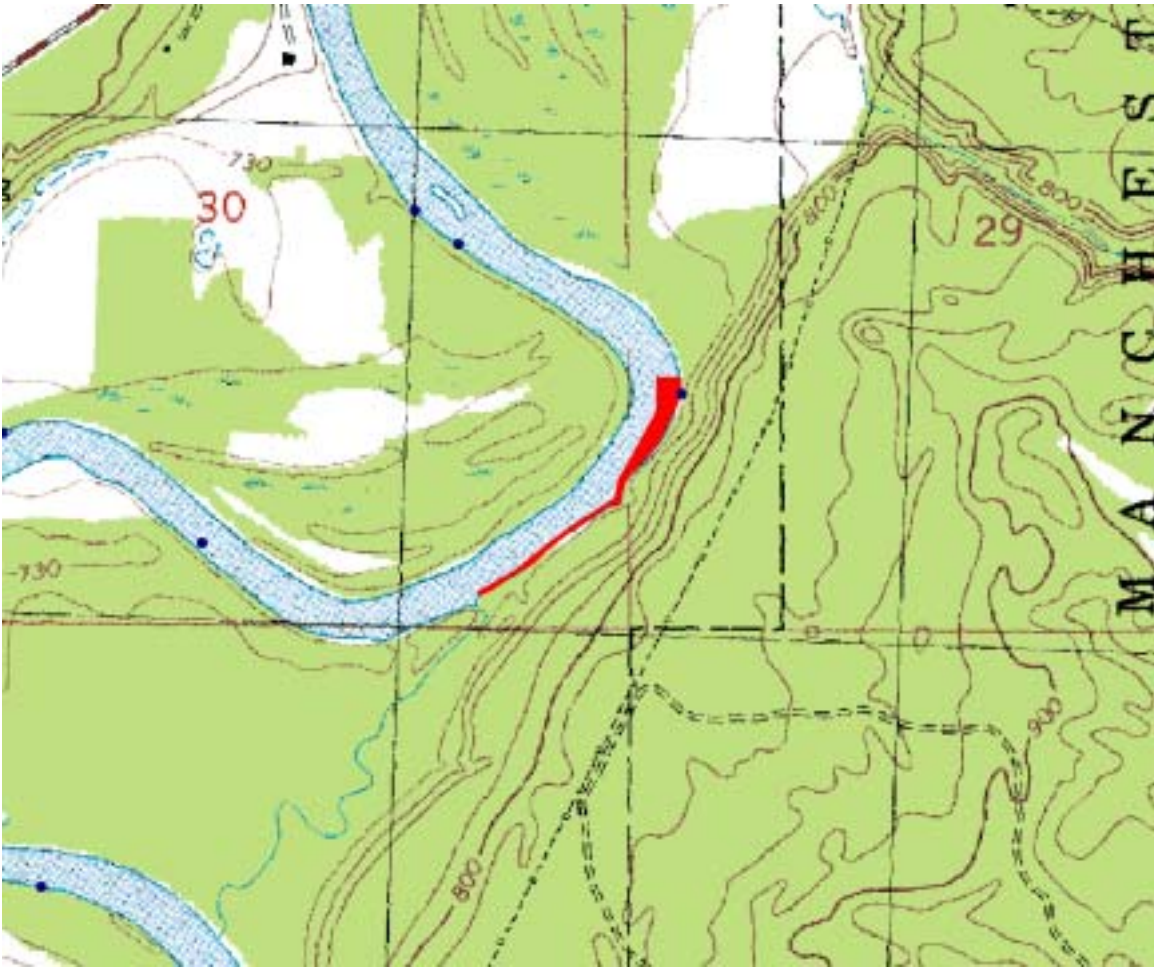
MUSSEL AGGREGATION "P"	
Latitude/Longitude	44° 14' 3.3"N, 90° 53' 3.6"W
Public Land Survey	Twp. 20N, Rng. 4W, Sec. 5 SW ¼, Jackson County, Wisconsin.
River Mile	55.9
Visually Est. Density	
Rank	4

Figure 12. Map of Mussel Aggregation "CB".



MUSSEL AGGREGATION "CB"	
Latitude/Longitude	44° 3' 35.3"N, 90° 17' 00.8"W
Public Land Survey	Twp. 18N, Rng. 8W, Sec. 1, La Crosse County, Wisconsin.
River Mile	14.2
Visually Est. Density	0.05/m ²
Rank	5

Figure 13. Map of Mussel Aggregation "AF".



MUSSEL AGGREGATION "AF"	
Latitude/Longitude	44° 10' 31.4"N, 90° 53' 34.7"W
Public Land Survey	Twp. 20N, Rng. 4W, Sec. 29 SW ¼, Twp. 20N, Rng. 4W, Sec. 30 SE ¼, Jackson County, Wisconsin.
River Mile	47.92
Visually Est. Density	
Rank	6

CONCLUSIONS AND RECOMMENDATIONS

- 1) A total of 125 gravel and rock bars were identified during a census of the lower 62.4 miles of the Black River, Wisconsin. The total surface area of bars (38.38 ha) covered 4% of the total instream surface area of 962.7 ha. The majority of gravel bars and the greatest proportion of bar surface area were located in the upstream one-third of the study reach.
- 2) Of the 71 bars that were examined in detail, 49 (69%) were mussel aggregations as defined here (>5 mussels/hour). The majority of mussel aggregations and the greatest proportion of aggregations surface area were located in the upstream one-third of the study reach.
- 3) A total of 23 species were represented among 1536 living individuals. One additional species was represented by a dead individual only. Black River species richness was somewhat lower than other large tributary stream to the Mississippi River in Wisconsin. More sampling may provide additional species.
- 4) The lower Black River may not contain a mussel community that is associated with the presence of *L. higginsii*. Only two of the taxa strongly associated with *L. higginsii* were found. This compares with the lower Wisconsin River, where *L. higginsii* is present, which has 9. A total of 2 moderate associates are present in the lower Black River while 3 are present in the lower Wisconsin River.
- 5) Of the 49 mussel aggregations, we recommended 5 based on CPH and total surface area as locations where *L. higginsii* introductions may be most successful. However, given the relatively low density of mussels, absence of *L. higginsii*, low numbers of associates, limited cage placement options, more suitable tributary and Mississippi River mainstem locations; other waterbodies may have a higher suitability for

introductions. However, the lower Black River may be suitable for a juvenile rearing waterbody for latter outplanting.

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Mathiak, Harold A. 1979. A river survey of the unionid mussels of Wisconsin, 1973-77. Sand Shell Press, Horicon, Wisconsin. 75 pp.

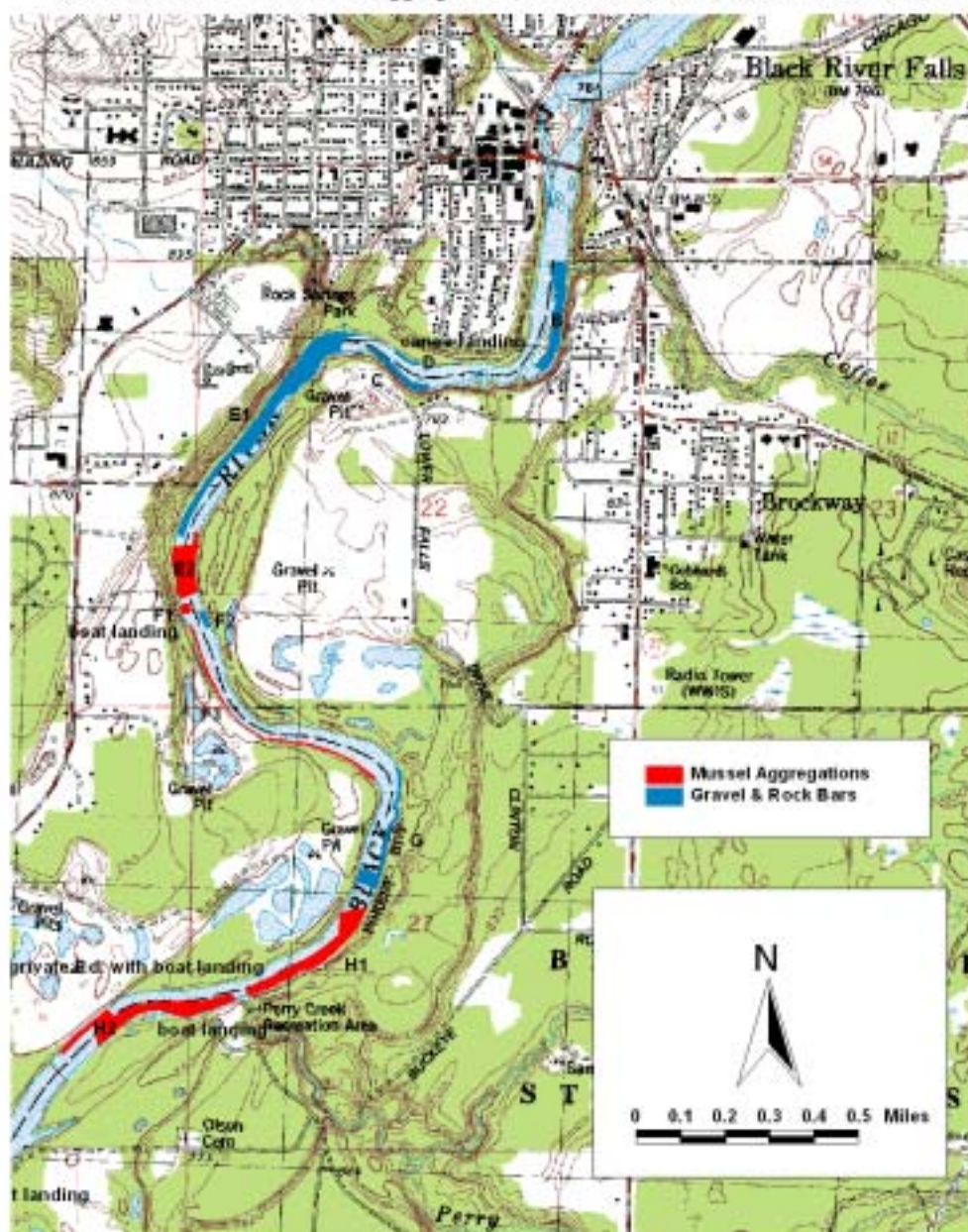
Miller, A. C. and B. S. Payne. 1997. Value of selected mussel beds in the upper Mississippi River for *Lampsilis higginsii*. Technical Report EL-97-13, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

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APPENDIX A

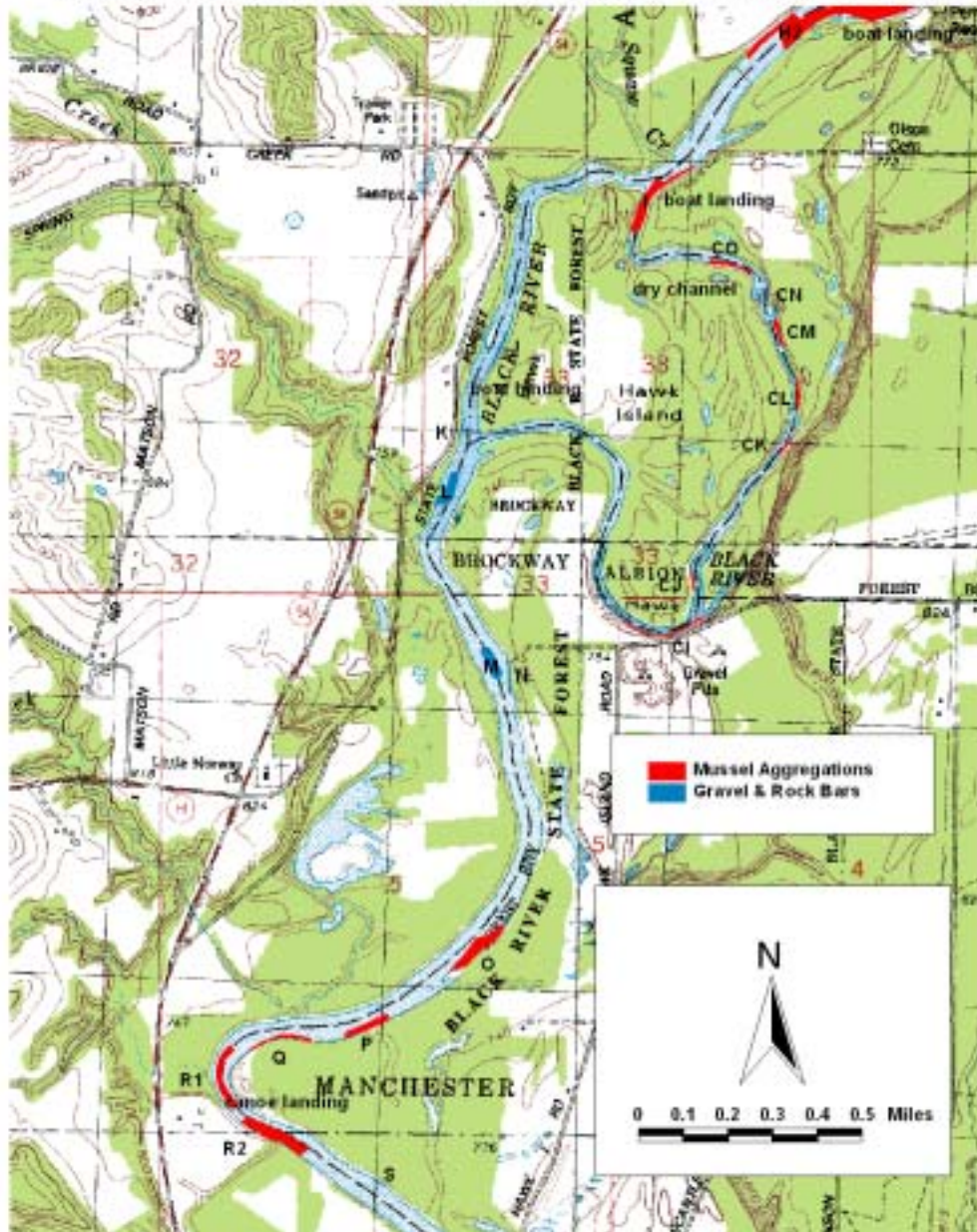
LOCATIONS OF GRAVEL BARS AND MUSSEL AGGREGATIONS IN THE LOWER BLACK RIVER, WISCONSIN, 2001-2002.

Gravel /Rock Bars and Mussel Aggregations, Lower Black River, River Miles 62.4 - 59.0



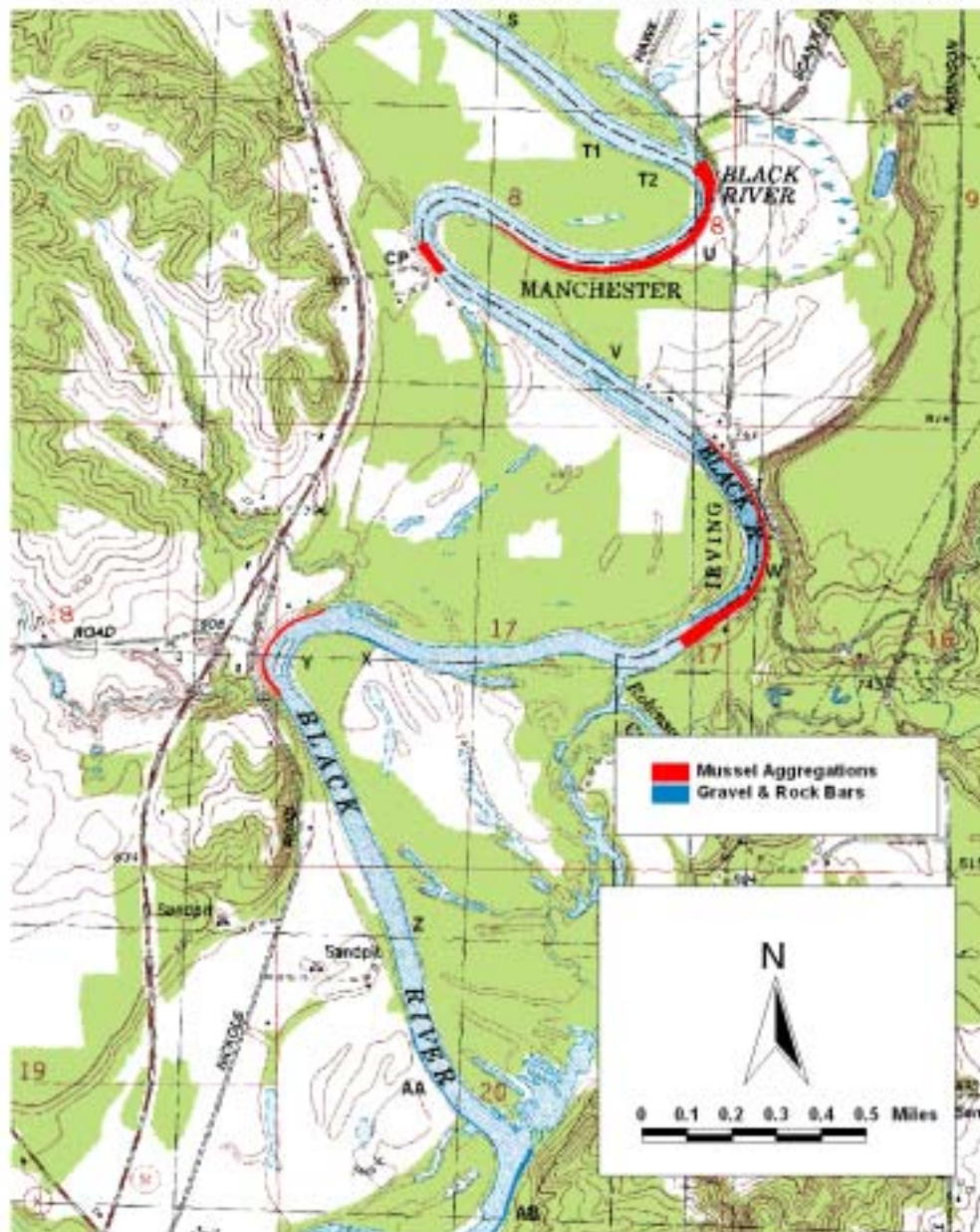
MAP CODE	RIVER MILE	PRIORITY	EXAMINED	BED	NOTES
A	62.17	3	n		Large rock w/ coarse sand and gravel interspersed grading to hard-packed sand 20m below canal outlet - appears poor but worth looking at for mussels. Loose coarse sand on each side of main current.
B	61.90	1	y	n	Around island, all but RDB channel looks OK. RDB too scoured. <i>L. siliquoidea</i> 4D, <i>L. complanata</i> (1 D), <i>L. cardium</i> (3D), <i>S. u. undulatus</i> (1 D), <i>L. recta</i> (2L) <i>L. siliquoidea</i> (2 L). LDB channel is very good. Gravel. At rock outcropping on LDB at lower end o
C	61.49	1	y	n	Small gravel bar. ~ 15m wide, LDB, Channel center sand. 080901: 20m wide. Rubble, boulders. Sand mound beyond 20m
D	61.49	1	n		Small gravel bar. ~ 10m wide, RDB, Channel center sand. <i>Lampsilis siliquoidea</i> (1L).
E1	61.08	1	y	n	E. RDB, Rock Springs, rubble. RDB large shoreline boulders for <i>Simpsonia</i> <i>ambigua</i> habitat. Mostly rock all across channel. Long stretch of rubble, gravel, and boulder. <i>Lampsilis cardium</i> (1D). 080901: Not a bed. Too much bedrock/boulder with sand between.
E2	60.72	1	y	y	E. RDB, Rock Springs, rubble. RDB large shoreline boulders for <i>Simpsonia</i> <i>ambigua</i> habitat. Mostly rock all across channel. Long stretch of rubble, gravel, and boulder. <i>Lampsilis cardium</i> (1D). Bar combined w/ E3.
F1	60.62	1	n	y	F. Downstream of rock pile on RDB and all way across but best on RDB along gravel shore. Mussel population density 2-5/m2. Upstream ~200m from power line. <i>Fusconaia flava</i> (3D), <i>Alasmodonta marginata</i> (1D), <i>Pleurobema sintoxia</i> (2D), <i>L. cardium</i> (1D). 44o 16
F2	60.58	2	y	n	LDB, gravel, 0-20m from shore, 44 o 16' 34", 90 o 51' 23".
F3	60.30	1	y	y	RDB, gravel, 0-3m off shore, 44o 16' 26.0", 90o 51' 10.6". Snorkeled ~20 min. Many, <i>L. cardium</i> (4L), <i>L. siliquoidea</i> , (12L, 1D), <i>P. alatus</i> (1L), <i>A. I. carinata</i> (2D), <i>L. recta</i> (1L, 2D), <i>L. f. raquilis</i> (1L.) Poor density.
G	59.84	2	n		G. LDB, 10m from shore, mostly boulder.
H1	59.38	2	y	y	H. LDB & center - rubble, goes to center.
H2	58.97	2	y	y	H. LDB & center - rubble, goes to center.. Best density on lower end.

Gravel /Rock Bars and Mussel Aggregations, Lower Black River, River Miles 59.0- 55.0



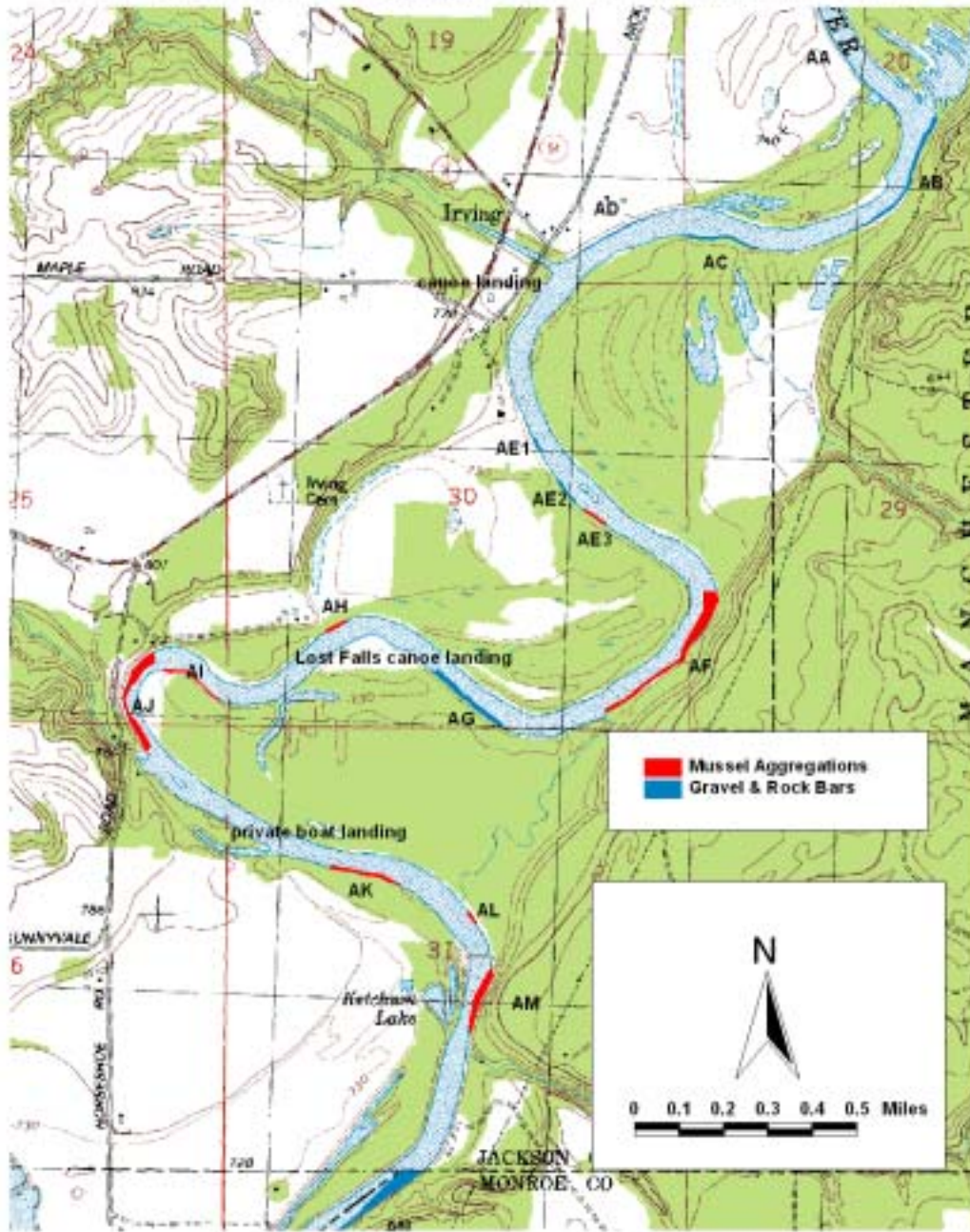
MAP CODE	RIVER MILE	PRIOR-ITY	EXAM-INED	BED	NOTES
I	58.45	2	y	y	I. LDB to 10m out, gravel, rubble. 080901: 6m wide at top, density, <1/m ² .
CO	58.09	3	y	y	about 6m wide, along RDB side of Hawk Is. channel. Poor density - most mussels in very shallow water, washed in.
CN	58.07	1	y	y	CN New bar. Shale, unknown width. (sampled 080901, ~3m wide, lots of mussels).
CM	58.01	1	y	y	CM Sampled. ~100m long.
CL	57.93	1	y	y	CL ~100m long (LDB of Hawk Is. Channel). Extends downstr. To 60m upstr of CK (Bedrock cliff). 15/m ² . Lower downstream 1/3 where is shallower. 7 m wide. Sampled 080701.
CK	57.92	1	y	y	LDB of Hawk Is. Channel. Along cliff. 5m wide for 40m, 7m for 40m then 3m for 30m. 110m long total. Mussel Pop. Den. appears lower where 3m wide. Lots of boulders. Sampled 080701.
J	57.80	3	y	n	J. LDB of RDB channel of Hawk Island, above Mason's Landing. 0-10m wide gravel, rubble. sampled 080701, low density, <1/m
K	57.64	3	n		K. RDB, 0-5m, gravel, below boat landing.
CJ	57.52	1	y	y	CJ 5mX80m. ~ 1/m ² mussel density - relatively high. Unstable but still mussels present. sampled 080701, ~1/m
CI	57.42	1	y	y	CI ~5m wide, ~3/m ² mussel density. Spotty for mussels. ~ 300m long. Sampled 080701, ~5 m wide, ~3/m
M	57.17	3	n		M. RDB, shallow, exposed gravel bar, small, low quality bed, 44 o 14' 46.1", 90o 52' 45.3".
N	57.02	3	n		N. LDB, Large midden, 60m downstream of grassy areas, LDB. See Wisconsin Mussel Survey Form. Counted nearly all. 44o 14' 42.2", 90o 52' 51.6". Extends downstream 100 m.
L	56.48	3	y	n	L. Cross stream LDB to RDB, near exposed gravel bar. sampled 080701, very low Population density.
O	56.19	2	y	y	O. LDB, 44o 14' 25.9", 90o 52' 46.4", 0-20m out from shore, gravel bar downs to head of island ~200m. Sampled 080701.
P	55.90	2	y	y	P. LDB, gravel, rubble bar. 44o 14' 3.0", 90o 53' 6.4" which is ~100m downstream from upstream end of bar.. sampled 080701, 20m wide just below grill.
Q	55.70	2	y	y	Q. LDB, across from creek mouths, 15m wide. Sampled 080701, ~10m wide, 5m wide below.
R1	55.50	2	y	n	R. Thalweg, bend, gravel.
R2	55.38	2	y	y	gravel, rip-rap shoreline.
S	55.08	3	n		S. LDB, 40m long, 5m wide, shoreline gravel bar. F. flava (1D).

Gravel /Rock Bars and Mussel Aggregations, Lower Black River, River Miles 55.0 - 50.0



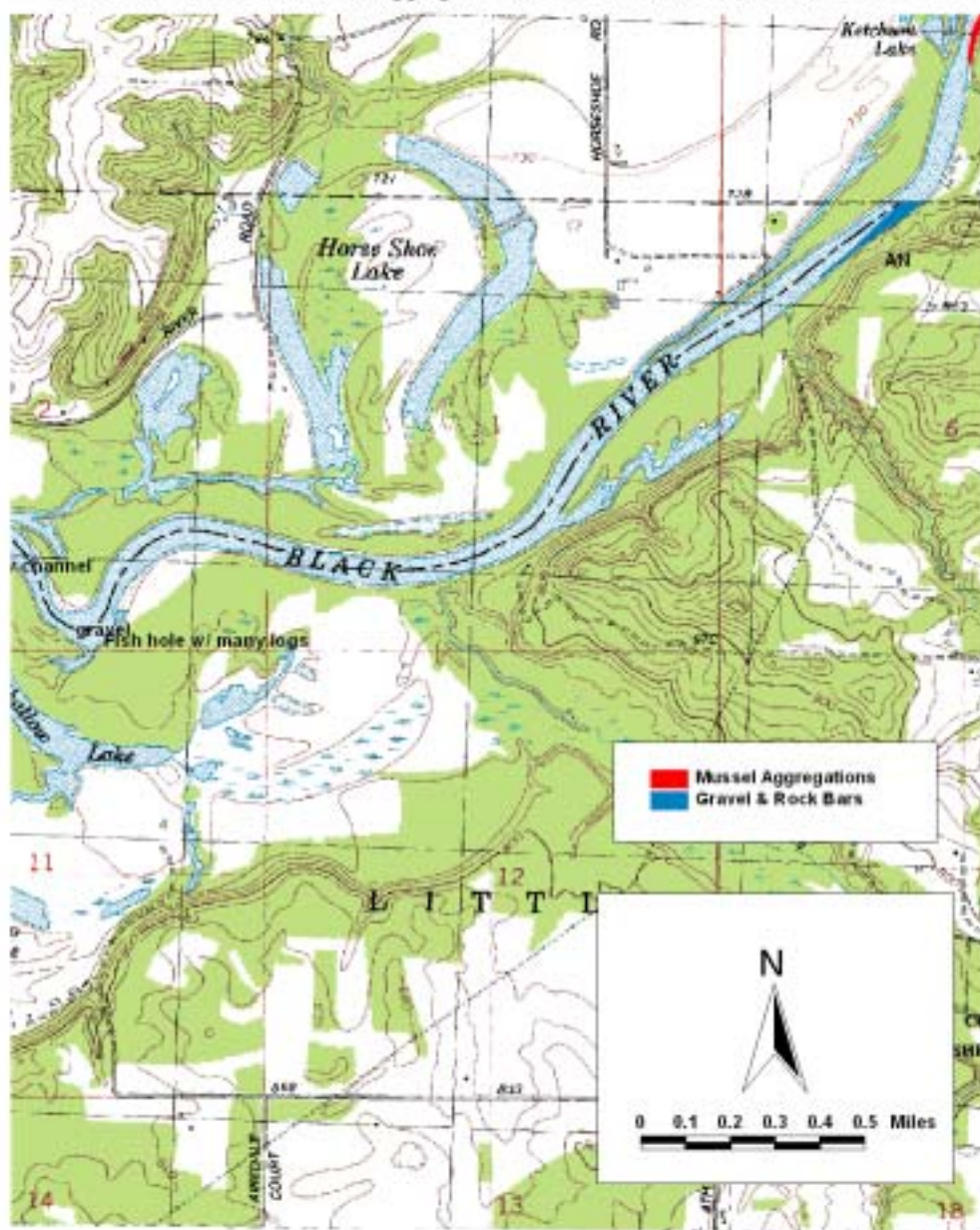
MAP CODE	RIVER MILE	PRIORITY	EXAMINED	BED	NOTES
T1	54.72	3	n		T. RDB, 70m long, 5m wide, gravel.
T2	54.60	3	n		T. RDB, 70m long, 5m wide, gravel.
U	54.21	1	y	y	U. LDB, 2/3 channel-width at upstream end, 5m at downstream end. Gravel, very long. Sampled 081601, is a bed. 20m wide.
CP	53.50	2	y	y	at existing known mussel bed.
V	53.10	2	n		V. LDB, across from Long Island, 8m wide, many large middens.
W	52.50	1	y	y	W. LDB, along high ground, 4m width upstream, ~0.1/m
X	51.53	3	n		X. LDB, narrow gravel, ~150m long.
Y	51.27	2	y	y	sampled 081601, is a bed.
Z	50.57	3	n		Z. LDB, 44o 12' 0.7", 90o 53' 75.2", 3m wide gravel, poor quality, few shells, ~100m long. L. recta (1D).
AA	50.18	3	n		AA. RDB, 4m wide, ~100m long.

Gravel /Rock Bars and Mussel Aggregations, Lower Black River, River Miles 50.0- 45.0



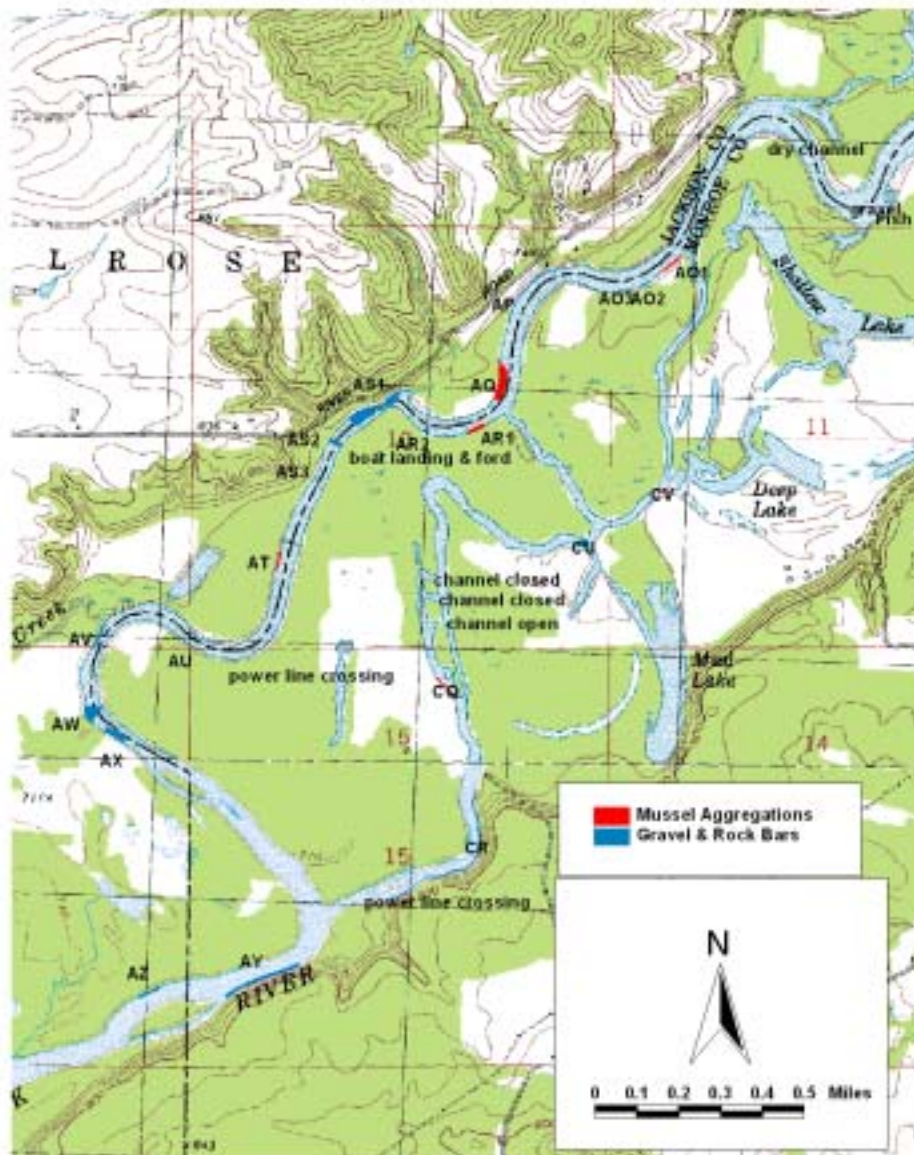
MAP CODE	RIVER MILE	PRIORITY	EXAMINED	BED	NOTES
AB	49.85	3	n		AB LDB, along bluff, ~15m wide, 5m at lower end. Mostly bedrock. Not great looking habitat.
AC	49.37	3	n		AC LDB, above Irving, spotty, location uncertain.
AD	49.14	3	n		AD RDB, above Irving, along grass. Very narrow, may be poor, may have sampled before.
AE1	48.57	2	n		
AE2	48.54	2	y	n	AE RDB, ~10m wide, fine gravel, ~50m long, 44o 10' 55.3", 90o 53' 58.8". There is an upper and lower segment to this bar, see map, RDB, 10m upstream of island. Dove 082702
AE3	48.46	2	y	y	AE RDB, ~10m wide, fine gravel, ~50m long, 44o 10' 55.3", 90o 53' 58.8". There is an upper and lower segment to this bar, see map, RDB, 10m upstream of island. Dove 082702
AF	47.92	2	y	y	AF LDB, along bluff and below, upper 081601, is a bed.
AG	47.40	2	y	n	AG LDB, 12m wide, mostly sandy, gravel. Sampled 082702, 20m wide. Very poor densities.
AH	47.05	2	y	n	AH RDB, small area above mouth and house - gravel. 0-5m out from shore. Sampled 082702, not a great location. bed ~10m wide. ~0.1/m
AI	46.67	2	y	y	AI LDB, ~200m long, gravel, opposite Lost Falls Campground. sampled 081601, is a bed. 6m wide.
AJ	46.45	3	y	y	AJ RDB, ~RMI 46.4, just below Lost Falls Campground. Wider at top (1/2 channel), 1/5 channel in middle, like very good gravel.
AK	45.77	3	y	y	AK RDB, 5-10m wide, ~250m long, gravel seam, 44o 10' 6.0", 90o 54' 35.2" (taken at head of bar). Waded 5 personXminutes, Tritogonia verrucosa (1L, 3D), F. flava (1L, 5D), L. silquidea (1L). Lots of shells.
AL	45.49	3	n	y	AL LDB, small, 50m long, 10m wide gravel/rubble. Shells present.
AM	45.32	2	y	y	AM LDB, along bluff, mostly bedrock except 0-5m from shore which is rubble. Shells present.

Gravel /Rock Bars and Mussel Aggregations, Lower Black River, River Miles 45.0 - 42.0



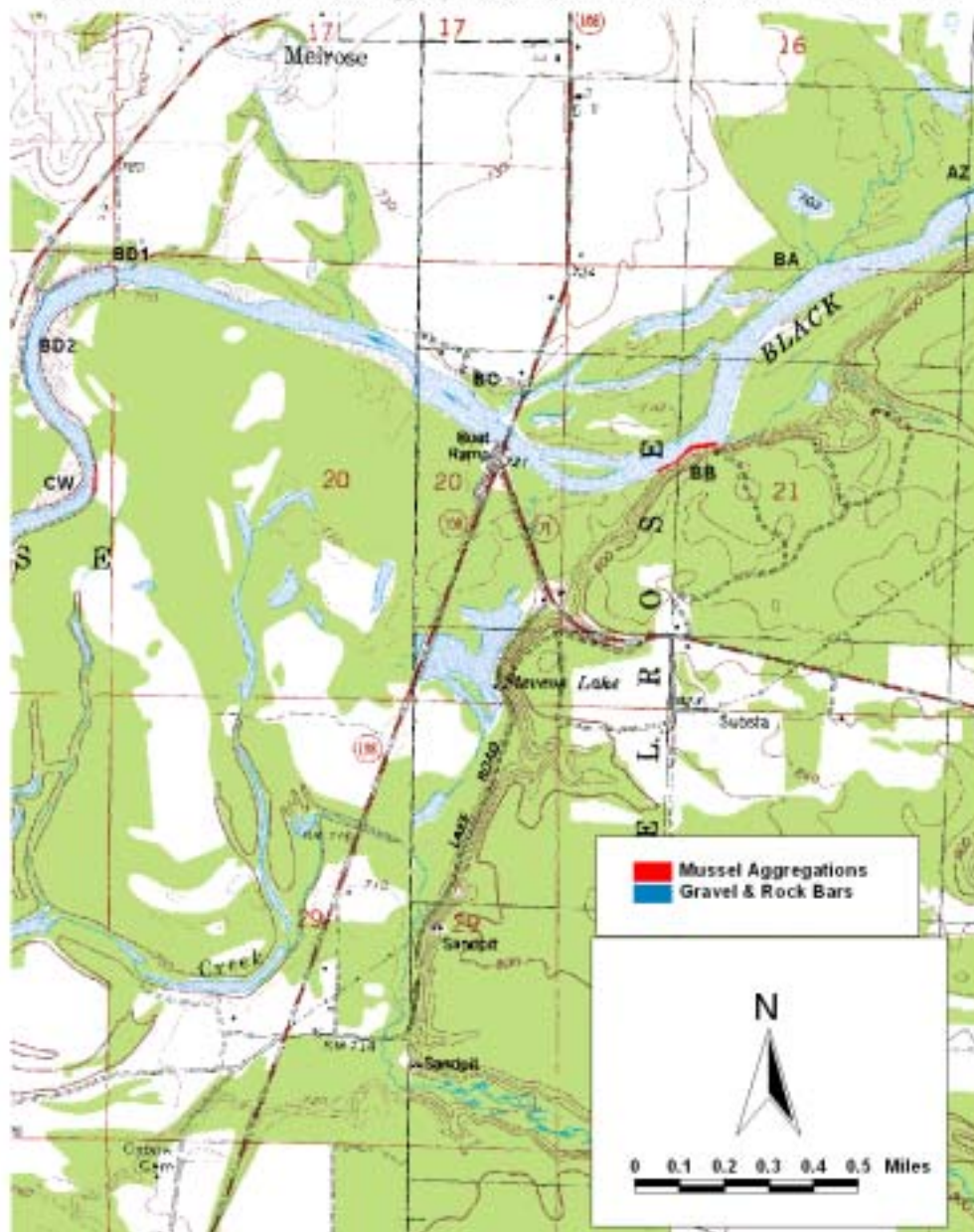
MAP CODE	RIVER MILE	PRIORITY	EXAMINED	BED	NOTES
AN	44.78	2	y	n	AN LDB. No shells present. Along bluff, at upper half of bar, goes out to mid-channel, all bedrock. The lower half of bar is 10m wide, more gravel and sand here. Waded downstr half, 081601, all bedrock.

Gravel/Rock Bars and Mussel Aggregations, Lower Black River, River Miles 42.0 - 38.0



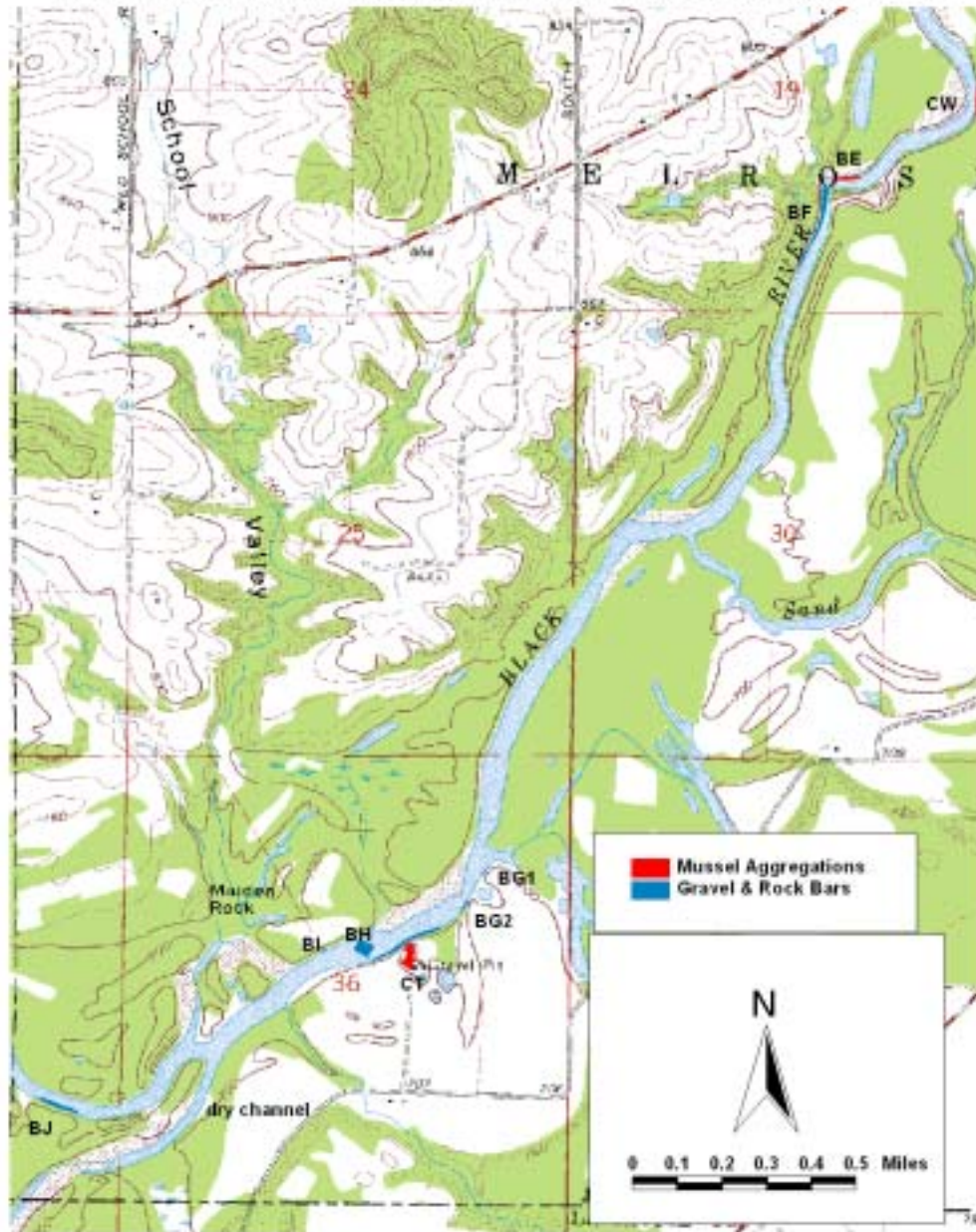
MAP CODE	RIVER MILE	PRIOR-ITY	EXAM-INED	BED	NOTES
AO1	41.82	3	y	n	AO LDB, below head of side-channel, 6m wide. 44o 08' 34.2", 90o 57' 7.8". GPS taken at 10m downstream of upper end of upstream patch. Contains 3 patches: upper one 80m and is the best. L. siliquioidea (2L), P. alatus (1L).
AO2	41.75	2	n		AO LDB, below head of side-channel, 6m wide. 44o 08' 34.2", 90o 57' 7.8". GPS taken at 10m downstream of upper end of upstream patch. Contains 3 patches: upper one 80m and is the best. L. siliquioidea (2L), P. alatus (1L).
AO3	41.50	2	n		AO LDB, below head of side-channel, 6m wide. 44o 08' 34.2", 90o 57' 7.8". GPS taken at 10m downstream of upper end of upstream patch. Contains 3 patches: upper one 80m and is the best. L. siliquioidea (2L), P. alatus (1L).
AP	41.45	3	n		AP RDB, from 50m upstream to 50m downstream of concrete rip-rap. Salamander mussel habitat in form of concrete slabs present. In upstream rest (downstream)
AQ	41.27	2	y	y	AQ Gravel to mid-channel. Shells present. 44o 08' 16.4", 90o 57' 32.1". GPS taken at lower 081601, deleted upper half. Rest 0.3/m
CV	41.16	2	y	y	along pasture, observed gravel on shoreline. Examined 082702.
CU	41.15	2	y	n	along pasture, observed rock on shoreline. Dove 10 mins. 082702, no mussels found. 20m wide.
AR1	41.10	2	y	y	AR LDB, from 1-6m from shore in center. 30m long. Downstream segment 10m wide, 15m long. Sampled 082703, 0.3-0.5/m
AR2	40.99	2	n		AR LDB, from 1-6m from shore in center. 30m long. Downstream segment 10m wide, 15m long.
AS1	40.85	3	n		AS RDB, along cliff. Primarily bedrock, gravel on bedrock. Sand interface, gravel fan below high ground. Lower segment at ford, rubble and sand. Very lowest segment along low cliff very narrow gravel, short (10m) along bedrock.
AS2	40.71	2	y	n	AS RDB, along cliff. Primarily bedrock, gravel on bedrock. Sand interface, gravel fan below high ground. Lower segment at ford, rubble and sand. Very lowest segment along low cliff very narrow gravel, short (10m) along bedrock.
AS3	40.64	3	n		AS RDB, along cliff. Primarily bedrock, gravel on bedrock. Sand interface, gravel fan below high ground. Lower segment at ford, rubble and sand. Very lowest segment along low cliff very narrow gravel, short (10m) along bedrock.
AT	40.42	2	y	y	AT RDB, 8 m wide, ~60m long. 44o 07' 55.1", 90o 58' 9.8". GPS taken at center. L. siliquioidea (2D). Dove 082702, >1/m
AU	40.02	3	n		AU LDB, cut bank, 4m wide, gravel, small - 20m long, below power line.
AV	39.76	2	y	n	AV RDB, 10m x 100m outwash from Douglas Creek. Looks OK. snorkled 081601, not a bed.
CQ	39.74	2	y	y	CQ New. ~ mi 39.1, E. channel. Not boated previously. Riffle ~100m long. At S end of forest opening on RDB, ~6m wide. GPS at upstr 1/3 of gravel: 44 40.0", 90
AW	39.59	2	y	n	AW RDB, gravel, near shore and in riffle, all across river at riffle. 50m long. Riffle has rubble, shallow. scuba 20pm, only 2 dead found.
AX	39.50	2	y	n	80m long, ~8m wide, gravel, rubble, shallow. Dove 082702, 30m wide, very low population density.
CR	39.11	3	n		08-16-2001CR Appeared like bedrock to sand.
AY	38.60	3	n		AY LDB, 10m wide, along cliff. Almost entirely bedrock, near shore boulders. Only potential is salamander mussels.
AZ	38.31	2	n		AZ RDB, 44o 07' 00.7", 90o 58' 30.9". Marginal, small area of gravel, 10m X 90m, deep, may be worth a look because of relatively greater depth.

Gravel /Rock Bars and Mussel Aggregations, Lower Black River, River Miles 38.0 - 35.3



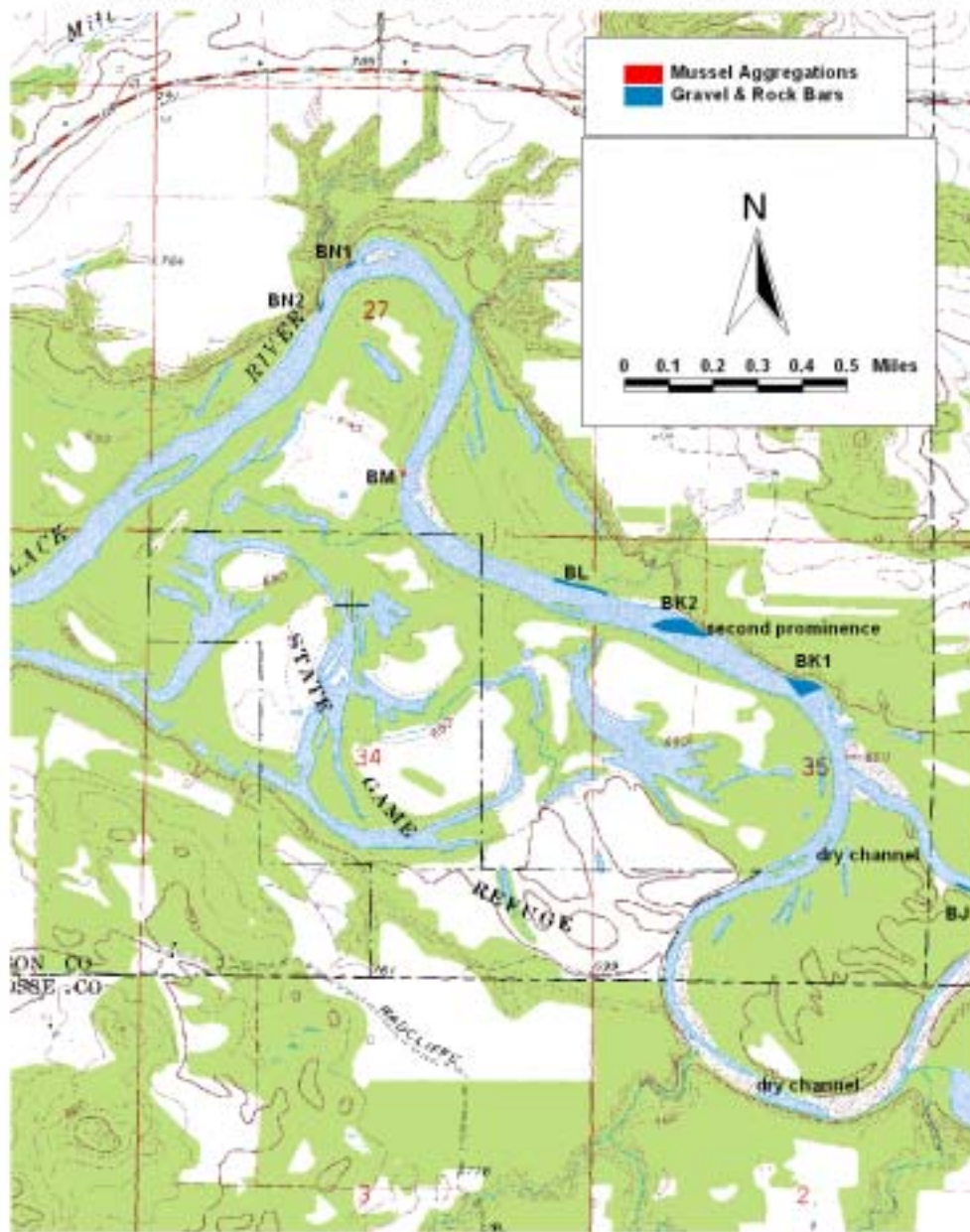
MAP CODE	RIVER MILE	PRIORITY	EXAMINED	BED	NOTES
BA	37.87	3	n		BA RDB, 4m X 20m, gravel. Poor to marginal.
BB	37.40	1	y	y	BB LDB, along rock face. Many slabs in water. Muddy at upstream end - great salamander mussel habitat. GPS taken at head of bed: 44o 06' 31.4", 90o 59' 12.8". 10m wide at upper end which is mud, boulder. Narrows to bedrock, sand. Point has shallow rubble
BC	36.91	3	n		BC Concrete rip-rap, only potential is for salamander mussels 20 m long.
BD1	36.09	3	n		BD RDB, along very large sand bank. Small gravel/rubble point at upstream end, then all sand downstream until new rip-rap, then old rip-rap. All mussel habitat would be along sand/rip-rap interface except two other points where goes out w/ rubble ~8m. A
BD2	35.80	3	n		BD RDB, along very large sand bank. Small gravel/rubble point at upstream end, then all sand downstream until new rip-rap, then old rip-rap. All mussel habitat would be along sand/rip-rap interface except two other points where goes out w/ rubble ~8m. A
CW	35.47	2	y	y	evidently examined 081601.

Gravel /Rock Bars and Mussel Aggregations, Lower Black River, River Miles 35.3 - 32.0



MAP CODE	RIVER MILE	PRIOR-ITY	EXAM-INED	BED	NOTES
BE	35.08	2	y	y	BE RDB, upstream of still pocket which is just upstream of cliff. Gravel, ~6m wide, ~100m long.
BF	34.96	3	n		BF RDB, rock face. From head to 100m downstream from creek gorge. Primarily bedrock, wider at upstream end, some gravel at bedrock/sand interface. Potential salamander mussel habitat.
BG1	33.14	3	n		BG LDB, 2-6m X 40m, gravel patches.
BG2	33.06	3	n		BG LDB, 2-6m X 40m, gravel patches.
BH	32.92	2	y	n	BH LDB, upstream of powerline, along old gravel pit. Gravel 5-10m out. Lower segment in RDB channel , at riffle. Upstream of power line 20m. Sampled 082101. is not a bed.
CT	32.91	3	y	y	sampled 082101. Adjacent to bed BH. ~1/m. Was designated C.J. Backwater area.
BI	32.74	3	n		BI RDB, 2m X 20m, gravel. Center of bar GPS = 44o 04' 32.2", 91o 02' 43.9". Small.
BJ	32.00	3	n		BJ LDB, uncertain of location, 0m - 10 m out from shore is gravel, patchy, much sand. 44o 04' 23.9", 91o 03' 25.1".

Gravel /Rock Bars and Mussel Aggregations, Lower Black River, River Miles 32.0 - 28.0



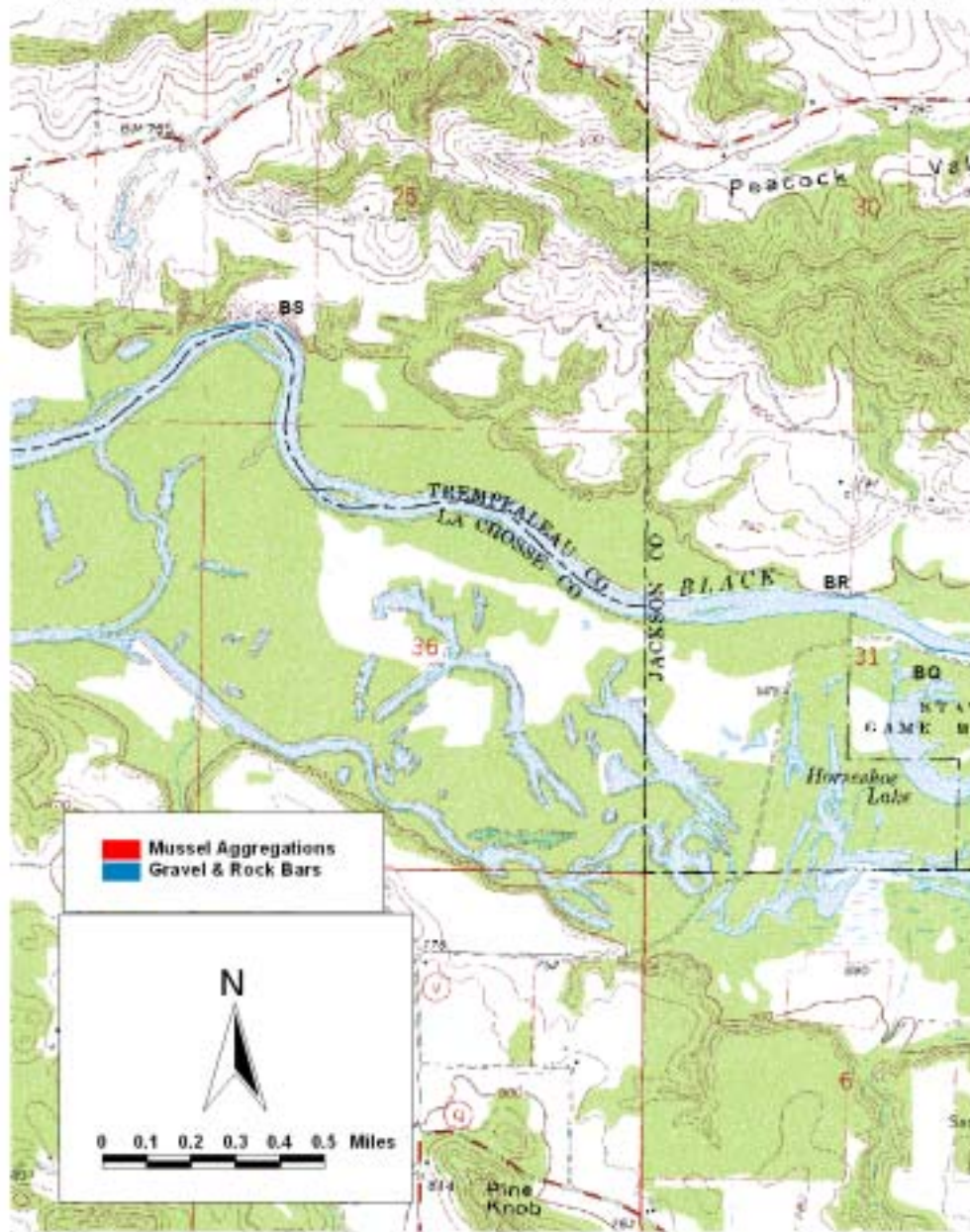
MAP CODE	RIVER MILE	PRIORITY	EXAMINED	BED	NOTES
BK1	31.37	3	n		BK RDB and lower segment in center. Upper segment mostly bedrock out to channel center. Rest below this sand up to bedrock shore. Lower prominence has rubble, gravel and looks better for mussels and extends into channel center 150m.
BK2	31.07	2	y	n	BK RDB and lower segment in center. Upper segment mostly bedrock out to channel center. Rest below this sand up to bedrock shore. Lower prominence has rubble, gravel and looks better for mussels and extends into channel center 150m.
BL	30.82	3	n		BL RDB, in deep channel (4 ft). Pea-sized gravel scoured. Extends from 0 - 10m from shore. May be marginal due to scouring.
BM	30.30	2	y	y	BM LDB, 20m X 8 m. Gravel, at eroded bank and meadow. 44o 05' 16.0", 91o 04' 52.5". L. recta (1L), L. silioquidea (1L), F. flava (1L), L. fragilis (3L). Snorkeled ~ 35 person X minutes.
BN1	29.64	3	n		BN RDB, two outcroppings. Bedrock to sand, 5-15m wide. Appears like poor mussel habitat.
BN2	29.55	3	n		BN RDB, two outcroppings. Bedrock to sand, 5-15m wide. Appears like poor mussel habitat.

Gravel /Rock Bars and Mussel Aggregations, Lower Black River, River Miles 28.0 - 25.8



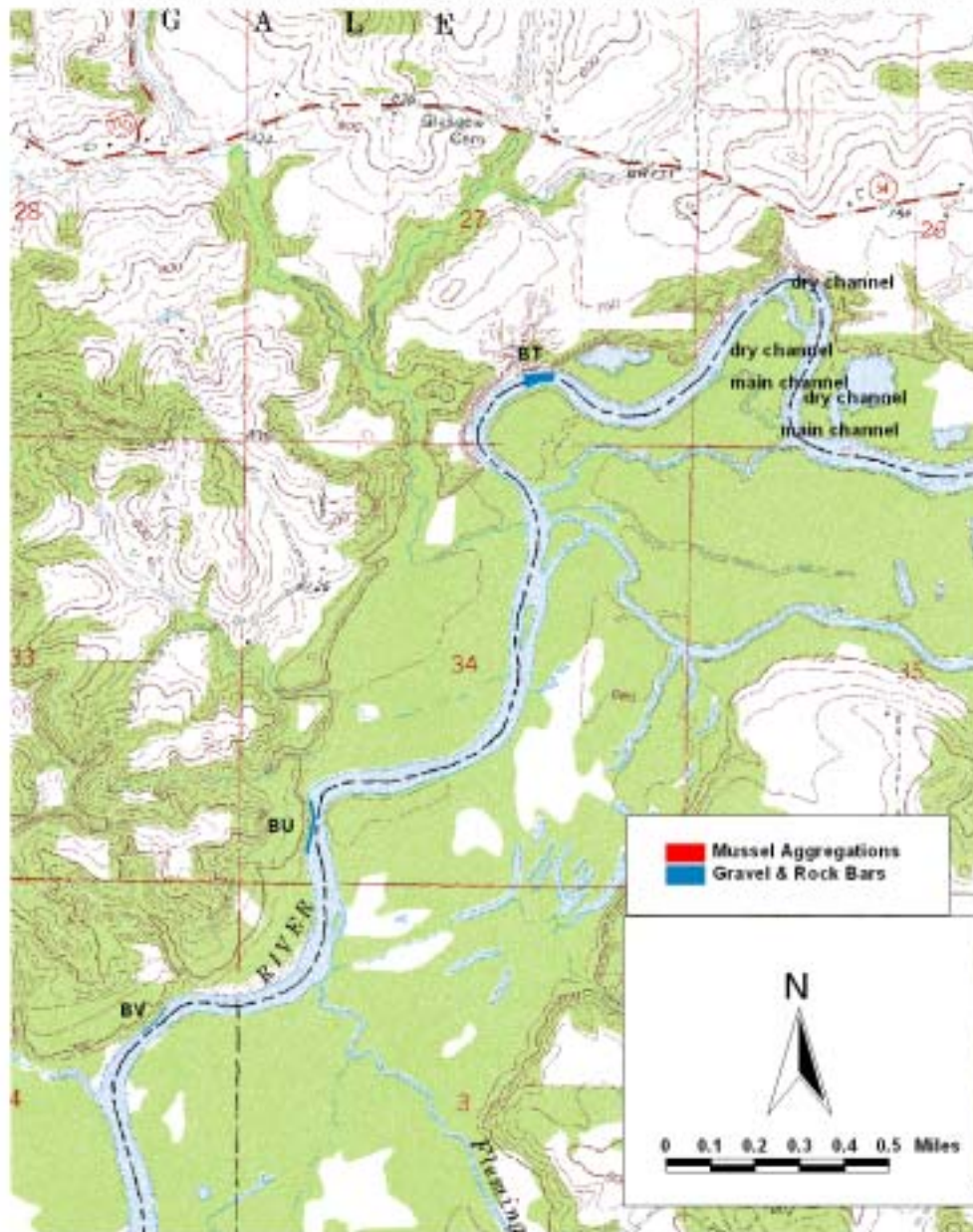
MAP CODE	RIVER MILE	PRIORITY	EXAMINED	BED	NOTES
BO	27.37	3	n		BO RDB, rip-rap - North Ben. Rip-rap 0-3m out, then sand. Only rip-rap/sand interface could be good habitat for mussels.
BP1	26.66	3	n		BP RDB, all bedrock, 0-5m out from shore, then sand from 5m out. No gravel, rubble. Poor habitat for mussels except maybe <i>S. ambigua</i> .
BP2	26.52	3	n		BP RDB, all bedrock, 0-5m out from shore, then sand from 5m out. No gravel, rubble. Poor habitat for mussels except maybe <i>S. ambigua</i> .
BQ	25.98	3	n		BQ LDB, along artificial rip-rap. Boulder/rubble 0-4m from shore. Could be potential for <i>S. ambigua</i> .

Gravel /Rock Bars and Mussel Aggregations, Lower Black River, River Miles 25.8 - 23.0



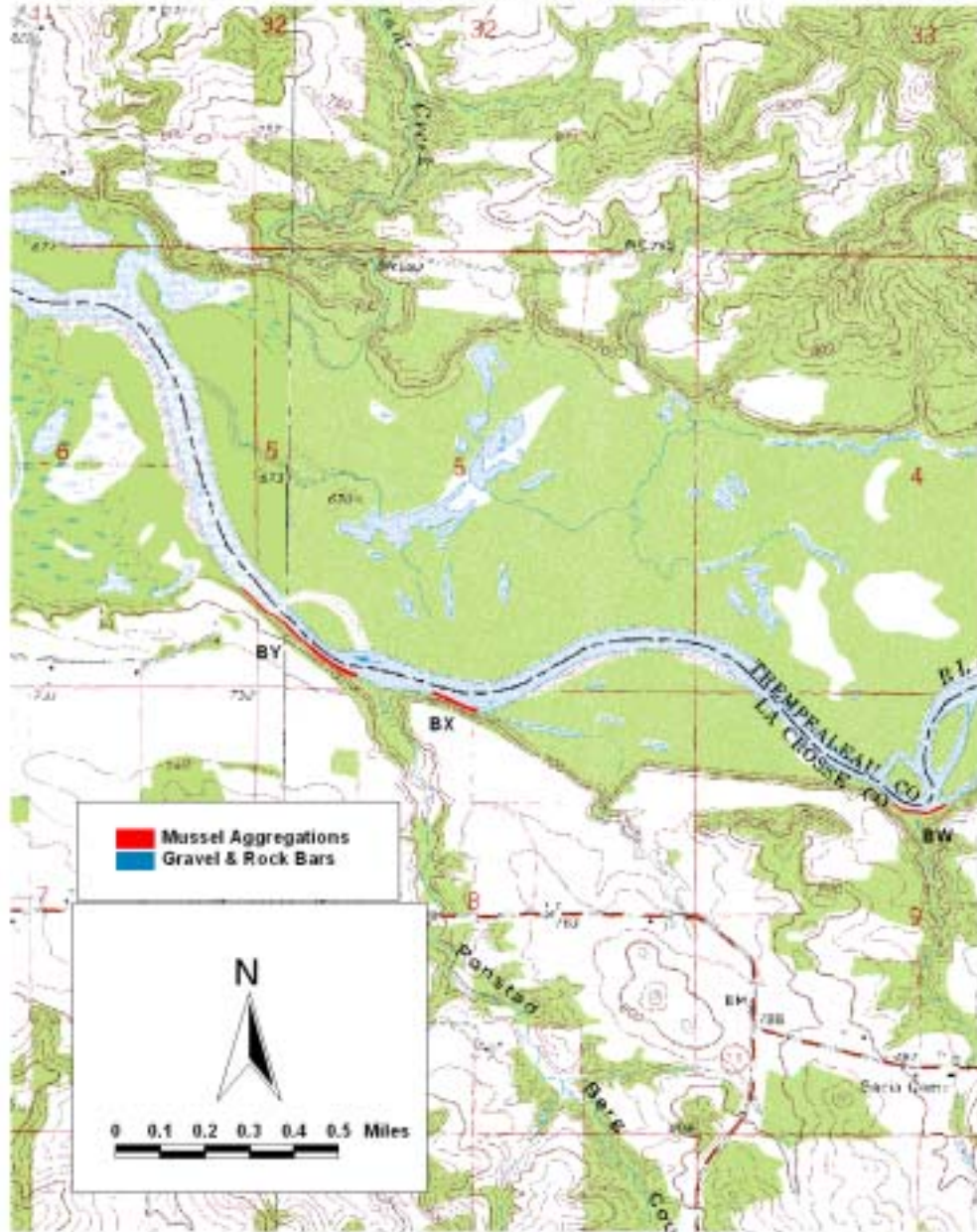
MAP CODE	RIVER MILE	PRIORITY	EXAMINED	BED	NOTES
BR	25.76	3	y	n	BR RDB, cliffs along North Bend Golf Course. Upstream half of bar: 4m wide, bedrock, then sand out from there. Downstream half: all sand - cliffs extend directly into sand of riverbed. Not a bed based on substrate, not SCUBA.
BS	23.99	3	y	n	BS RDB, along sandy eroded bank, 4-6m out - pea-sized gravel over pocked clay. Poor, narrow. Some gravel/rubble at water line. Not a bed based on substrate, not SCUBA.

Gravel /Rock Bars and Mussel Aggregations, Lower Black River, River Miles 23.0 - 19.0



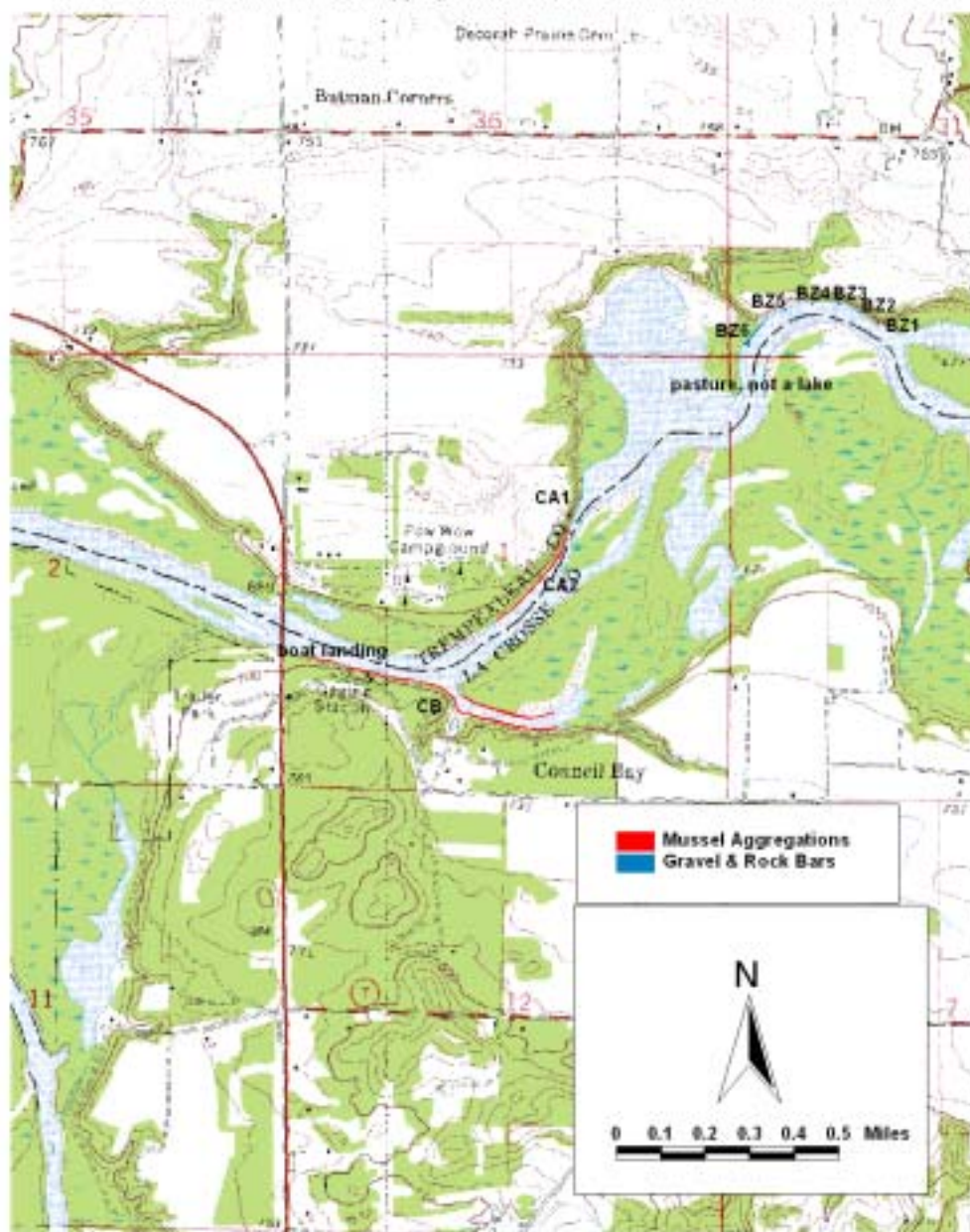
MAP CODE	RIVER MILE	PRIOR-ITY	EXAM-INED	BED	NOTES
BT	21.85	2	y	n	RDB, from where high ground meets R downstr to upstr of Cr mouth ~ 50m (ALL OFF MAP). All bedrock w/ rapids about 2/3 way out in ch & downstr plunge pool. Poor Pot. habitat except for pool. Rapids is very shallow. No gravel bar. Sampled 082101.
BU	20.34	3	n		BU RDB, primarily bedrock, ~0-10m out. Poor potential mussel habitat but a few very large boulders in downstream end - potential <i>S. ambigua</i> habitat.
BV	19.62	3	n		BV RDB, primarily bedrock. No rubble or gravel. Bedrock butt up against sand. Poor potential mussel habitat.

Gravel /Rock Bars and Mussel Aggregations, Lower Black River, River Miles 19.0 - 16.0



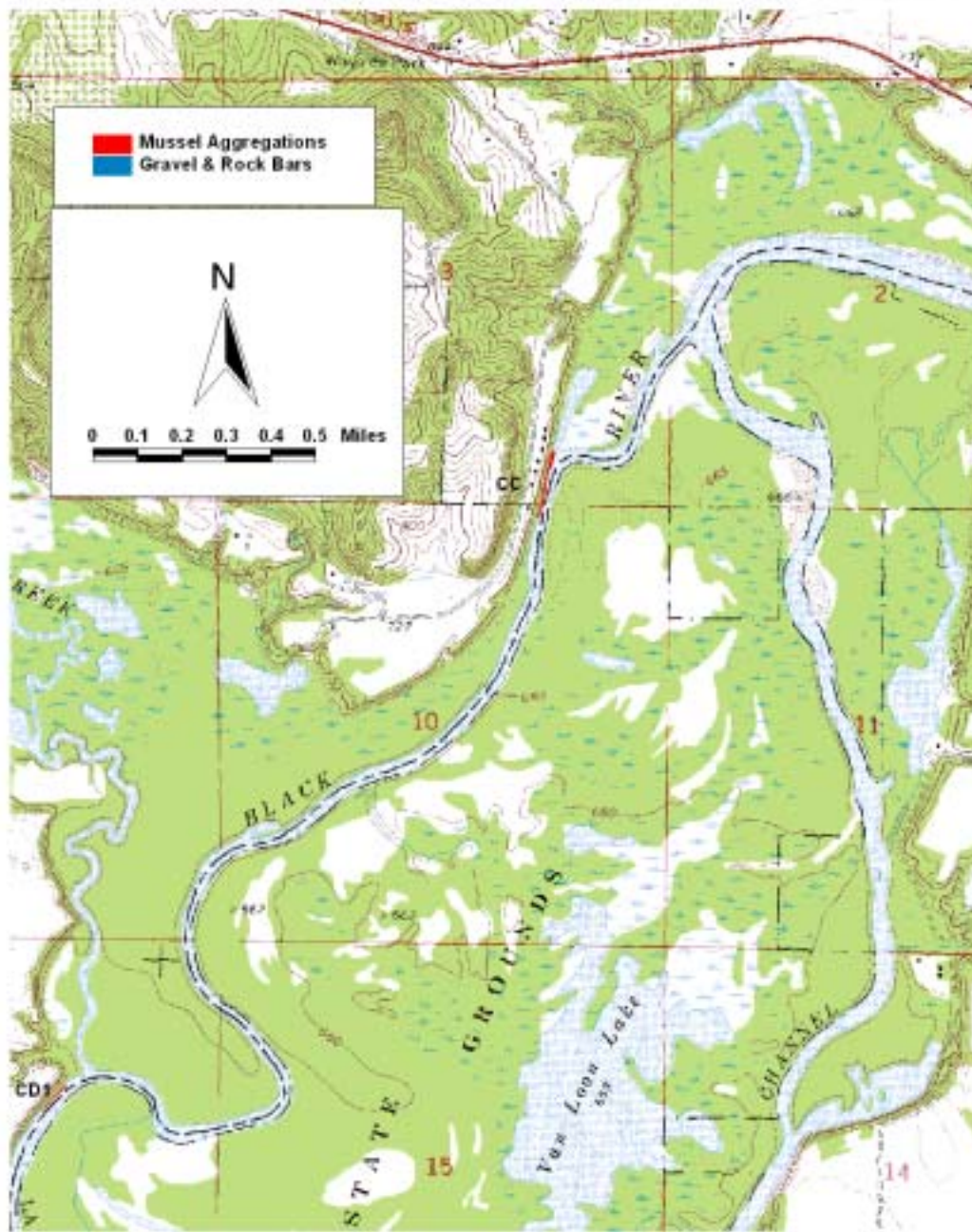
MAP CODE	RIVER MILE	PRIOR-ITY	EXAM-INED	BED	NOTES
BW	18.48	1	y	y	BW LDB, on sharp bend. Primarily bedrock with some rubble and boulders. Looks promising for mussel habitat. Sampled 082101.
BX	17.37	1	y	y	BX LDB, looks very good for mussel habitat. Many mussels seen. Rubble 0-5 m out, 5-10m bedrock, then sand out from here. Sampled 082100. Is a very good bed.
BY	16.99	1	y	y	BY LDB, ~500m long., 10m wide. Rubble in upstream half. In downstream half, 5m wide rubble. Looks very good potential mussel habitat. Starts at upstream house. Sampled 082100. Less than 1/m.

Gravel /Rock Bars and Mussel Aggregations, Lower Black River, River Miles 16.0- 13.0



MAP CODE	RIVER MILE	PRIORITY	EXAMINED	BED	NOTES
BZ1	15.64	2	y	y	BZ RDB. A series of about 5 rock groin-like structures. See map. Downstream 200m is rubble along shore, 0-3m out with downstream-most end of this a linear area 20m wide. Sampled 082101.
BZ2	15.61	2	n		BZ RDB. A series of about 5 rock groin-like structures. See map. Downstream 200m is rubble along shore, 0-3m out with downstream-most end of this a linear area 20m wide.
BZ3	15.55	2	y	n	BZ RDB. A series of about 5 rock groin-like structures. See map. Downstream 200m is rubble along shore, 0-3m out with downstream-most end of this a linear area 20m wide. Sampled 082100.
BZ4	15.50	2	n		BZ RDB. A series of about 5 rock groin-like structures. See map. Downstream 200m is rubble along shore, 0-3m out with downstream-most end of this a linear area 20m wide.
BZ5	15.44	2	n		BZ RDB. A series of about 5 rock groin-like structures. See map. Downstream 200m is rubble along shore, 0-3m out with downstream-most end of this a linear area 20m wide.
BZ6	15.37	2	y	n	BZ RDB. A series of about 5 rock groin-like structures. See map. Downstream 200m is rubble along shore, 0-3m out with downstream-most end of this a linear area 20m wide. Sampled 082101.
CA1	14.76	3	n		CA RDB, E of camp ground, rubble, 2-3m wide. Has small upstream reach at downstream end of pasture (was a lake on the quad map). Lower bed much longer, 2-3m wide.
CA2	14.58	3	y	y	CA RDB, E of camp ground, rubble, 2-3m wide. Has small upstream reach at downstream end of pasture (was a lake on the quad map). Lower bed much longer, 2-3m wide. Sampled 082301.
CB	14.20	2	y	y	CB LDB, Council Bay and channel downstream of bay. Mussels present. Near shore area of bay had sandy, stable habitat. dove in bay and downstr of 082301.

Gravel /Rock Bars and Mussel Aggregations, Lower Black River, River Miles 13.0 - 9.6.



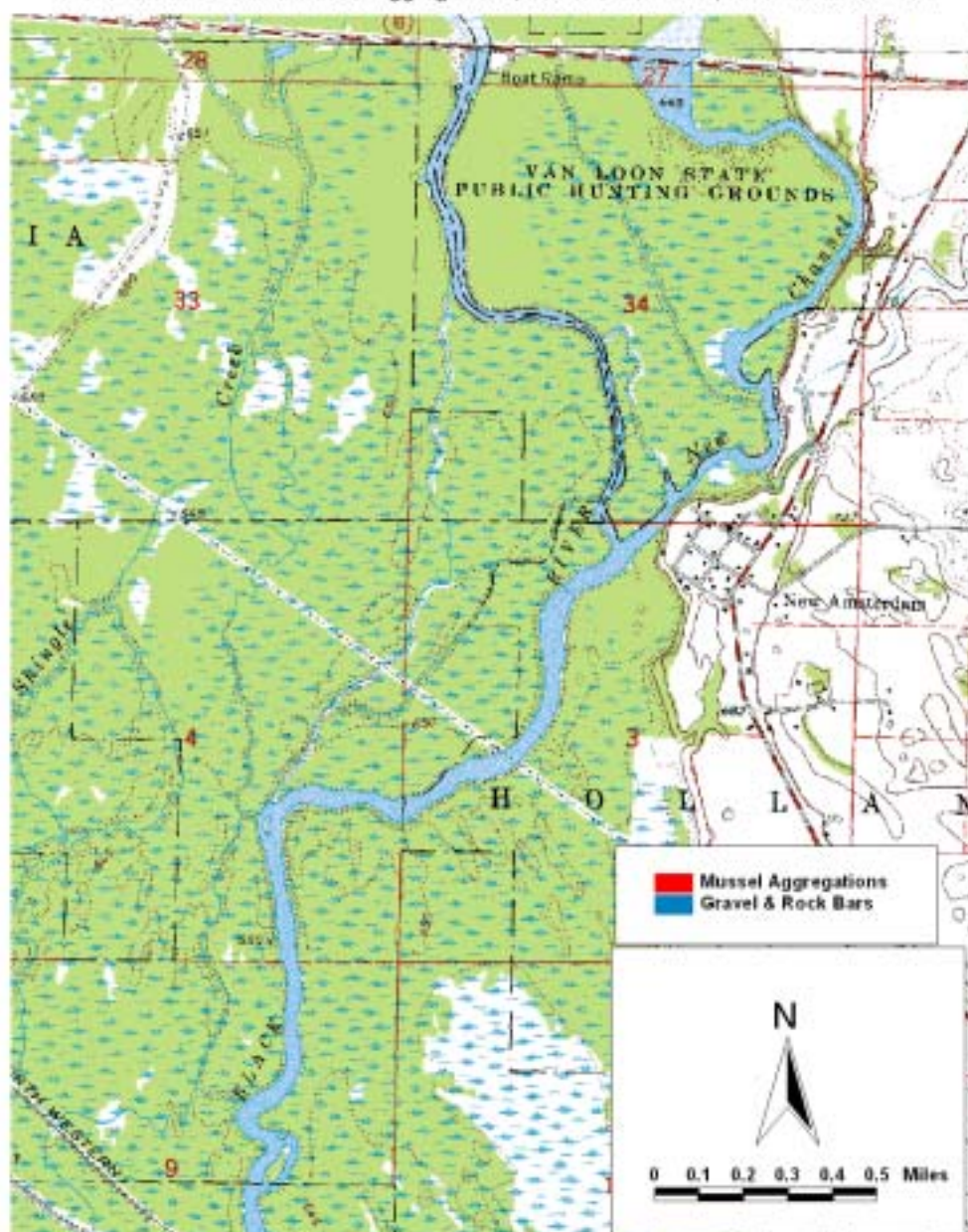
MAP CODE	RIVER MILE	PRIORITY	EXAMINED	BED	NOTES
CC	12.29	1	y	y	CC RDB, along low cliffs and houses. 12m wide at upstream end (ie 0-12m out from shore), 4m wide at downstream 2/3's of bed. Mostly layered bedrock with lots of undercut ledges for <i>S. ambigua</i> . dove 082301.
CD1	9.80	3	y	y	CD RDB, 2 locations along eroded bank. 1-3m out from shoreline. Sandy gravel. Looks marginal to poor for mussels. Dove 082301.

Gravel /Rock Bars and Mussel Aggregations, Lower Black River, River Miles 9.6 - 6.6.



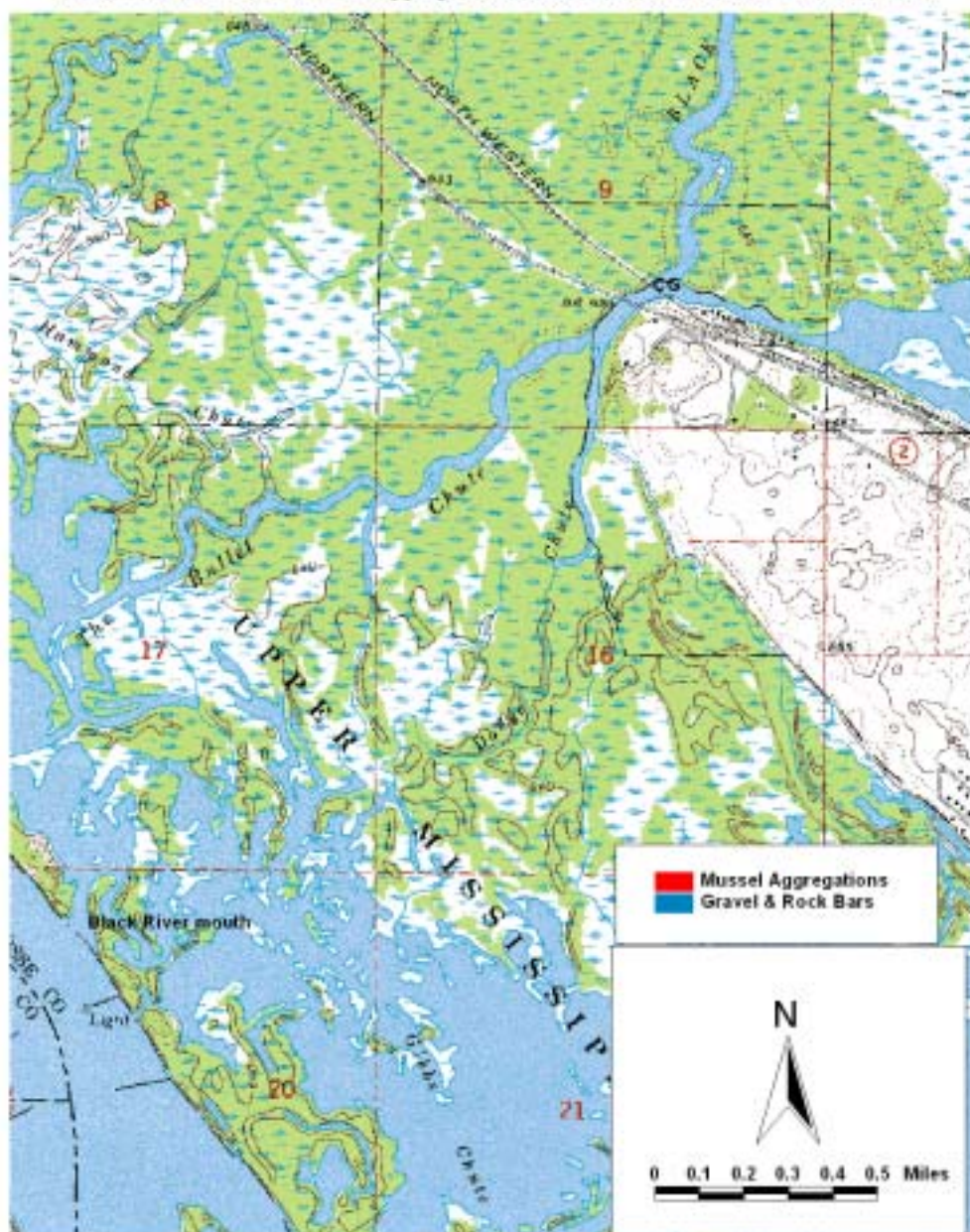
MAP CODE	RIVER MILE	PRIOR-ITY	EXAM-INED	BED	NOTES
CD2	9.49	3	n		CD RDB, 2 locations along eroded bank. 1-3m outs from shroeline. Sandy gravel. Looks marginal to poor for mussels.
CE	8.75	2	y	y	CE RDB, 3mX150m. Along eroded bank. Sandy gravel. Looks OK. Dove 082301, not a bed.
CF1	8.24	3	y	y	CF RDB, along eroded bank. Upper 1/2 (is a known bed) has width of width. Has a downstr. separate segment, 50m long, 10m wide, sandy gravel. Substrate here appears
CF2	8.11	3	n		CF RDB, along eroded bank. Upper 1/2 (is a known bed) has width of width. Has a downstr. separate segment, 50m long, 10m wide, sandy gravel. Substrate here appears

Gravel /Rock Bars and Mussel Aggregations, Lower Black River, River Miles 6.6 - 3.5.



MAP CODE	RIVER MILE	PRIOR- ITY	EXAM- INED	BED	NOTES

Gravel /Rock Bars and Mussel Aggregations, Lower Black River, River Miles 3.5 - 0.0.



MAP CODE	RIVER MILE	PRIOR- ITY	EXAM- INED	BED	NOTES
CG	2.66	3	n		CG LDB, Lytle's Landing, 1-2m wide of rip-rap off bank.

APPENDIX B

MUSSEL DATA FROM THE LOWER BLACK RIVER, WISCONSIN, 2001-2002.

RIVER MILE	MAP CODE	SPECIES	LIVE	DEAD
61.9	BED B	<i>A. l. carinata</i>	0	1
61.9	BED B	<i>L. siliquioidea</i>	2	4
61.9	BED B	<i>L. cardium</i>	0	3
61.9	BED B	<i>L. c. complanata</i>	0	1
61.9	BED B	<i>L. recta</i>	2	0
61.9	BED B	<i>S. u. undulatus</i>	0	1
61.88	BED B	<i>L. cardium</i>	0	1
61.88	BED B	<i>L. c. complanata</i>	0	2
61.49	BED D	<i>L. siliquioidea</i>	1	0
61.44	BED C	<i>L. cardium</i>	0	1
61.23	BED E1	<i>A. g. form corpulenta</i>	1	1
61.23	BED E1	<i>L. siliquioidea</i>	0	2
61.23	BED E1	<i>L. fragilis</i>	0	2
61.23	BED E1	<i>P. sintoxia</i>	0	1
61.08	BED E1	<i>L. cardium</i>	0	1
60.96	BED E1	<i>A. p. plicata</i>	1	0
60.96	BED E1	<i>F. flava</i>	1	3
60.96	BED E1	<i>L. siliquioidea</i>	1	1
60.96	BED E1	<i>L. cardium</i>	3	0
60.96	BED E1	<i>L. fragilis</i>	2	0
60.96	BED E1	<i>L. recta</i>	2	0
60.96	BED E1	<i>S. u. undulatus</i>	1	0
60.65	BED E2	<i>A. l. carinata</i>	1	1
60.65	BED E2	<i>L. siliquioidea</i>	2	0
60.65	BED E2	<i>L. cardium</i>	8	1
60.65	BED E2	<i>L. c. complanata</i>	1	0
60.65	BED E2	<i>L. fragilis</i>	1	1
60.65	BED E2	<i>L. recta</i>	5	0
60.65	BED E2	<i>P. sintoxia</i>	7	1
60.62	BED F1	<i>A. marginata</i>	1	0
60.62	BED F1	<i>A. g. form corpulenta</i>	1	1
60.62	BED F1	<i>F. flava</i>	9	0
60.62	BED F1	<i>L. siliquioidea</i>	2	0
60.62	BED F1	<i>L. cardium</i>	5	0
60.62	BED F1	<i>L. fragilis</i>	2	1
60.62	BED F1	<i>P. sintoxia</i>	10	0
60.62	BED F1	<i>T. truncata</i>	1	1
60.54	BED F3	<i>L. siliquioidea</i>	1	0
60.54	BED F3	<i>P. sintoxia</i>	0	1
60.38	BED F3	<i>F. flava</i>	0	1
60.38	BED F3	<i>L. siliquioidea</i>	0	1
60.38	BED F3	<i>P. sintoxia</i>	2	4
60.3	BED F3	<i>A. l. carinata</i>	0	2
60.3	BED F3	<i>F. flava</i>	2	1

60.3	BED F3	<i>L. siliquoidea</i>	12	1
60.3	BED F3	<i>L. cardium</i>	4	0
60.3	BED F3	<i>L. fragilis</i>	1	1
60.3	BED F3	<i>L. recta</i>	1	2
60.3	BED F3	<i>P. alatus</i>	1	0
59.4	BED H1	<i>A. g. form corpulenta</i>	5	0
59.4	BED H1	<i>F. flava</i>	5	44
59.4	BED H1	<i>L. siliquoidea</i>	0	2
59.4	BED H1	<i>L. cardium</i>	2	1
59.4	BED H1	<i>L. c. complanata</i>	1	0
59.4	BED H1	<i>L. costata</i>	0	1
59.4	BED H1	<i>L. fragilis</i>	2	2
59.4	BED H1	<i>P. alatus</i>	6	0
59.4	BED H1	<i>T. verrucosa</i>	1	1
58.89	BED H2	<i>A. l. carinata</i>	0	2
58.89	BED H2	<i>A. g. form corpulenta</i>	1	5
58.89	BED H2	<i>F. flava</i>	0	3
58.89	BED H2	<i>L. siliquoidea</i>	1	10
58.89	BED H2	<i>L. cardium</i>	0	33
58.89	BED H2	<i>L. c. complanata</i>	2	3
58.89	BED H2	<i>L. fragilis</i>	1	7
58.89	BED H2	<i>L. recta</i>	0	1
58.89	BED H2	<i>P. sintoxia</i>	4	3
58.89	BED H2	<i>T. truncata</i>	1	0
58.41	BED I	<i>A. l. carinata</i>	0	1
58.41	BED I	<i>A. g. form corpulenta</i>	2	0
58.41	BED I	<i>F. flava</i>	1	1
58.41	BED I	<i>L. siliquoidea</i>	1	2
58.41	BED I	<i>L. cardium</i>	2	1
58.41	BED I	<i>L. c. complanata</i>	2	1
58.41	BED I	<i>L. fragilis</i>	0	3
58.41	BED I	<i>L. recta</i>	1	1
58.41	BED I	<i>P. sintoxia</i>	2	7
58.1	BED CO	<i>A. l. carinata</i>	0	1
58.1	BED CO	<i>A. g. form corpulenta</i>	10	4
58.1	BED CO	<i>F. flava</i>	0	1
58.1	BED CO	<i>L. siliquoidea</i>	5	10
58.1	BED CO	<i>L. cardium</i>	6	30
58.1	BED CO	<i>L. c. complanata</i>	3	6
58.1	BED CO	<i>L. fragilis</i>	2	10
58.1	BED CO	<i>L. recta</i>	2	7
58.1	BED CO	<i>P. sintoxia</i>	1	8
58.1	BED CO	<i>P. alatus</i>	0	1
58.01	BED CM	<i>A. l. carinata</i>	4	1
58.01	BED CM	<i>A. marginata</i>	3	2
58.01	BED CM	<i>A. g. form corpulenta</i>	37	12

58.01	BED CM	<i>F. flava</i>	23	42
58.01	BED CM	<i>L. siliquoidea</i>	9	13
58.01	BED CM	<i>L. cardium</i>	16	24
58.01	BED CM	<i>L. c. complanata</i>	77	6
58.01	BED CM	<i>L. compressa</i>	0	1
58.01	BED CM	<i>L. costata</i>	9	3
58.01	BED CM	<i>L. fragilis</i>	8	2
58.01	BED CM	<i>L. recta</i>	5	4
58.01	BED CM	<i>P. sintoxia</i>	30	17
58.01	BED CM	<i>P. alatus</i>	6	0
58.01	BED CM	<i>Q. pustulosa pustulosa</i>	1	0
58.01	BED CM	<i>S. u. undulatus</i>	1	2
58.01	BED CM	<i>T. verrucosa</i>	2	1
58.01	BED CM	<i>T. truncata</i>	1	0
57.93	BED CL	<i>A. l. carinata</i>	1	0
57.93	BED CL	<i>A. g. form corpulenta</i>	3	0
57.93	BED CL	<i>F. flava</i>	1	0
57.93	BED CL	<i>L. siliquoidea</i>	0	2
57.93	BED CL	<i>L. cardium</i>	1	0
57.93	BED CL	<i>L. c. complanata</i>	5	0
57.93	BED CL	<i>L. fragilis</i>	1	0
57.93	BED CL	<i>L. recta</i>	1	0
57.93	BED CL	<i>P. sintoxia</i>	2	1
57.92	BED CK	<i>A. g. form corpulenta</i>	1	0
57.92	BED CK	<i>L. fragilis</i>	1	0
57.92	BED CK	<i>L. recta</i>	1	0
57.92	BED CK	<i>S. ambigua</i>	0	0
57.85	BED J	<i>A. g. form corpulenta</i>	1	0
57.85	BED J	<i>F. flava</i>	0	5
57.85	BED J	<i>L. cardium</i>	1	2
57.85	BED J	<i>L. fragilis</i>	0	1
57.85	BED J	<i>L. recta</i>	0	1
57.85	BED J	<i>S. u. undulatus</i>	0	1
57.52	BED CJ	<i>F. flava</i>	0	6
57.52	BED CJ	<i>P. sintoxia</i>	3	5
57.48	BED L	<i>A. l. carinata</i>	0	2
57.48	BED L	<i>A. marginata</i>	0	1
57.48	BED L	<i>F. flava</i>	0	4
57.48	BED L	<i>L. cardium</i>	1	11
57.48	BED L	<i>L. c. complanata</i>	0	2
57.48	BED L	<i>L. recta</i>	0	1
57.35	BED CI	<i>A. marginata</i>	1	0
57.35	BED CI	<i>A. g. form corpulenta</i>	3	0
57.35	BED CI	<i>F. flava</i>	0	1
57.35	BED CI	<i>L. cardium</i>	0	7
57.35	BED CI	<i>L. c. complanata</i>	3	0

57.35	BED CI	<i>L. fragilis</i>	2	0
57.35	BED CI	<i>L. recta</i>	1	0
57.35	BED CI	<i>P. alatus</i>	1	0
57.03	BED N	<i>A. l. carinata</i>	0	2
57.03	BED N	<i>A. marginata</i>	0	1
57.03	BED N	<i>F. flava</i>	6	131
57.03	BED N	<i>L. siliquoidea</i>	0	6
57.03	BED N	<i>L. cardium</i>	0	21
57.03	BED N	<i>L. fragilis</i>	0	2
57.03	BED N	<i>L. recta</i>	0	2
57.03	BED N	<i>P. sintoxia</i>	0	21
57.03	BED N	<i>P. alatus</i>	0	1
57.03	BED N	<i>T. verrucosa</i>	1	0
57.03	BED N	<i>T. truncata</i>	0	4
56.18	BED O	<i>A. l. carinata</i>	1	0
56.18	BED O	<i>A. marginata</i>	3	0
56.18	BED O	<i>F. flava</i>	3	1
56.18	BED O	<i>L. siliquoidea</i>	1	0
56.18	BED O	<i>L. cardium</i>	2	1
56.18	BED O	<i>L. c. complanata</i>	2	0
56.18	BED O	<i>L. costata</i>	1	0
56.18	BED O	<i>L. fragilis</i>	1	0
56.18	BED O	<i>P. sintoxia</i>	4	0
56.18	BED O	<i>S. u. undulatus</i>	2	0
56.18	BED O	<i>T. verrucosa</i>	1	0
55.89	BED P	<i>A. marginata</i>	2	0
55.89	BED P	<i>F. flava</i>	5	1
55.89	BED P	<i>L. siliquoidea</i>	1	0
55.89	BED P	<i>L. cardium</i>	8	1
55.89	BED P	<i>L. costata</i>	2	0
55.89	BED P	<i>P. sintoxia</i>	6	4
55.65	BED Q	<i>L. cardium</i>	3	0
55.65	BED Q	<i>P. sintoxia</i>	0	3
55.54	BED R1	<i>A. g. form corpulenta</i>	1	0
55.54	BED R1	<i>F. flava</i>	1	5
55.54	BED R1	<i>L. siliquoidea</i>	0	1
55.54	BED R1	<i>L. cardium</i>	1	0
55.54	BED R1	<i>L. c. complanata</i>	1	1
55.54	BED R1	<i>L. fragilis</i>	1	0
55.54	BED R1	<i>L. recta</i>	1	0
55.54	BED R1	<i>P. sintoxia</i>	2	5
55.37	BED R2	<i>F. flava</i>	1	1
55.37	BED R2	<i>L. siliquoidea</i>	1	0
55.37	BED R2	<i>L. cardium</i>	2	1
55.37	BED R2	<i>L. c. complanata</i>	4	0
55.37	BED R2	<i>L. fragilis</i>	2	0

55.37	BED R2	<i>L. recta</i>	1	0
55.08	BED S	<i>F. flava</i>	0	1
54.34	BED U	<i>A. l. carinata</i>	3	0
54.34	BED U	<i>A. marginata</i>	2	0
54.34	BED U	<i>A. g. form corpulenta</i>	2	0
54.34	BED U	<i>F. flava</i>	4	0
54.34	BED U	<i>L. siliquoidea</i>	3	2
54.34	BED U	<i>L. cardium</i>	2	2
54.34	BED U	<i>L. c. complanata</i>	5	0
54.34	BED U	<i>L. costata</i>	0	1
54.34	BED U	<i>L. fragilis</i>	6	1
54.34	BED U	<i>L. recta</i>	3	0
54.34	BED U	<i>P. sintoxia</i>	6	3
54.34	BED U	<i>P. alatus</i>	5	0
54.34	BED U	<i>S. u. undulatus</i>	1	1
54.34	BED U	<i>T. verrucosa</i>	4	0
53.5	BED CP	<i>A. l. carinata</i>	1	0
53.5	BED CP	<i>A. marginata</i>	1	0
53.5	BED CP	<i>A. g. form corpulenta</i>	10	0
53.5	BED CP	<i>F. flava</i>	25	21
53.5	BED CP	<i>L. siliquoidea</i>	6	0
53.5	BED CP	<i>L. cardium</i>	1	2
53.5	BED CP	<i>L. c. complanata</i>	2	2
53.5	BED CP	<i>L. fragilis</i>	0	1
53.5	BED CP	<i>L. recta</i>	1	0
53.5	BED CP	<i>P. alatus</i>	1	0
53.5	BED CP	<i>S. u. undulatus</i>	2	1
53.5	BED CP	<i>T. verrucosa</i>	3	0
53.5	BED CP	<i>unidentified</i>	0	1
52.27	BED W	<i>A. g. form corpulenta</i>	1	2
52.27	BED W	<i>F. flava</i>	1	30
52.27	BED W	<i>L. siliquoidea</i>	0	1
52.27	BED W	<i>L. c. complanata</i>	0	2
52.27	BED W	<i>L. fragilis</i>	0	1
52.27	BED W	<i>P. sintoxia</i>	0	2
52.27	BED W	<i>T. verrucosa</i>	0	1
51.19	BED Y	<i>A. l. carinata</i>	0	1
51.19	BED Y	<i>F. flava</i>	1	3
51.19	BED Y	<i>L. siliquoidea</i>	0	1
51.19	BED Y	<i>L. cardium</i>	1	1
51.19	BED Y	<i>L. fragilis</i>	1	0
51.19	BED Y	<i>L. recta</i>	1	1
51.19	BED Y	<i>P. sintoxia</i>	1	3
51.19	BED Y	<i>P. alatus</i>	0	2
51.19	BED Y	<i>S. ambigua</i>	11	0
51.19	BED Y	<i>T. verrucosa</i>	1	0

50.61	BED Z	<i>L. recta</i>	0	1
48.54	BED AE2	<i>L. siliquioidea</i>	0	1
48.54	BED AE2	<i>L. cardium</i>	0	2
48.54	BED AE2	<i>L. recta</i>	0	1
48.46	BED AE3	<i>A. l. carinata</i>	1	0
48.46	BED AE3	<i>L. siliquioidea</i>	1	2
48.46	BED AE3	<i>L. c. complanata</i>	1	0
48.46	BED AE3	<i>L. fragilis</i>	2	4
48.46	BED AE3	<i>L. recta</i>	5	2
48.46	BED AE3	<i>P. alatus</i>	2	1
48.46	BED AE3	<i>T. verrucosa</i>	1	0
48.06	BED AF	<i>A. l. carinata</i>	0	3
48.06	BED AF	<i>F. flava</i>	4	29
48.06	BED AF	<i>L. siliquioidea</i>	0	2
48.06	BED AF	<i>L. cardium</i>	0	2
48.06	BED AF	<i>L. fragilis</i>	0	3
48.06	BED AF	<i>L. recta</i>	0	2
48.06	BED AF	<i>P. sintoxia</i>	5	26
47.37	BED AG	<i>L. siliquioidea</i>	1	0
47.05	BED AH	<i>A. l. carinata</i>	1	0
47.05	BED AH	<i>F. flava</i>	3	0
47.05	BED AH	<i>L. siliquioidea</i>	3	0
47.05	BED AH	<i>L. cardium</i>	3	0
47.05	BED AH	<i>L. fragilis</i>	2	0
47.05	BED AH	<i>L. recta</i>	2	0
47.05	BED AH	<i>P. alatus</i>	2	0
46.71	BED AI	<i>A. l. carinata</i>	1	0
46.71	BED AI	<i>A. marginata</i>	1	0
46.71	BED AI	<i>L. siliquioidea</i>	2	0
46.71	BED AI	<i>L. cardium</i>	2	0
46.71	BED AI	<i>L. c. complanata</i>	1	0
46.71	BED AI	<i>L. costata</i>	1	0
46.71	BED AI	<i>L. recta</i>	3	0
46.71	BED AI	<i>P. sintoxia</i>	2	0
46.71	BED AI	<i>T. verrucosa</i>	1	0
46.54	BED AJ	<i>L. siliquioidea</i>	1	2
46.54	BED AJ	<i>L. cardium</i>	1	1
46.54	BED AJ	<i>L. c. complanata</i>	1	0
46.54	BED AJ	<i>L. fragilis</i>	1	0
45.35	BED AM	<i>L. fragilis</i>	1	0
45.2	BED AK	<i>F. flava</i>	1	5
45.2	BED AK	<i>L. siliquioidea</i>	1	0
45.2	BED AK	<i>T. verrucosa</i>	1	3
41.82	BED AO1	<i>A. l. carinata</i>	1	0
41.82	BED AO1	<i>L. siliquioidea</i>	2	1
41.82	BED AO1	<i>L. c. complanata</i>	4	0

41.82	BED AO1	<i>L. fragilis</i>	3	0
41.82	BED AO1	<i>L. recta</i>	1	0
41.8	BED AO1	<i>L. siliquoidea</i>	2	0
41.8	BED AO1	<i>P. alatus</i>	1	0
41.27	BED AQ	<i>L. cardium</i>	0	2
41.27	BED AQ	<i>L. c. complanata</i>	0	3
41.25	BED AQ	<i>F. flava</i>	0	3
41.25	BED AQ	<i>L. siliquoidea</i>	2	5
41.25	BED AQ	<i>L. cardium</i>	9	1
41.25	BED AQ	<i>L. c. complanata</i>	1	1
41.25	BED AQ	<i>L. fragilis</i>	0	1
41.25	BED AQ	<i>L. recta</i>	2	0
41.25	BED AQ	<i>P. sintoxia</i>	1	1
41.25	BED AQ	<i>P. alatus</i>	2	0
41.16	BED CV	<i>L. siliquoidea</i>	1	0
41.16	BED CV	<i>L. cardium</i>	1	0
41.16	BED CV	<i>L. fragilis</i>	1	0
41.16	BED CV	<i>P. alatus</i>	1	0
41.12	BED AR1	<i>F. flava</i>	1	0
41.12	BED AR1	<i>L. siliquoidea</i>	3	0
41.12	BED AR1	<i>L. cardium</i>	4	1
41.12	BED AR1	<i>L. c. complanata</i>	6	0
41.12	BED AR1	<i>L. fragilis</i>	1	0
41.12	BED AR1	<i>L. recta</i>	4	0
41.12	BED AR1	<i>P. alatus</i>	1	0
40.42	BED AT	<i>L. siliquoidea</i>	0	3
40.41	BED AT	<i>F. flava</i>	2	0
40.41	BED AT	<i>L. siliquoidea</i>	7	0
40.41	BED AT	<i>L. cardium</i>	24	1
40.41	BED AT	<i>L. c. complanata</i>	3	0
40.41	BED AT	<i>L. fragilis</i>	3	0
40.41	BED AT	<i>L. recta</i>	1	0
40.41	BED AT	<i>P. sintoxia</i>	1	0
40.25	BED CQ	<i>A. l. carinata</i>	1	0
40.25	BED CQ	<i>L. siliquoidea</i>	2	4
40.25	BED CQ	<i>L. c. complanata</i>	2	0
40.25	BED CQ	<i>L. costata</i>	0	1
40.25	BED CQ	<i>L. recta</i>	2	0
39.78	BED AV	<i>L. cardium</i>	0	1
39.78	BED AV	<i>L. recta</i>	0	1
39.59	BED AW	<i>L. cardium</i>	0	1
39.59	BED AW	<i>L. recta</i>	0	1
39.5	BED AX	<i>L. cardium</i>	1	0
39.5	BED AX	<i>L. c. complanata</i>	1	0
39.5	BED AX	<i>L. fragilis</i>	1	0
39.5	BED AX	<i>L. recta</i>	1	0

37.49	BED BB	<i>A. l. carinata</i>	1	1
37.49	BED BB	<i>L. siliquioidea</i>	2	2
37.49	BED BB	<i>L. c. complanata</i>	7	1
37.49	BED BB	<i>L. fragilis</i>	6	0
37.49	BED BB	<i>L. recta</i>	1	1
37.49	BED BB	<i>P. sintoxia</i>	1	5
37.49	BED BB	<i>P. alatus</i>	6	0
37.49	BED BB	<i>S. ambigua</i>	88	12
37.49	BED BB	<i>T. verrucosa</i>	1	0
37.47	BED BB	<i>A. l. carinata</i>	0	1
37.47	BED BB	<i>F. flava</i>	0	1
37.47	BED BB	<i>L. siliquioidea</i>	2	0
37.47	BED BB	<i>L. c. complanata</i>	0	1
37.47	BED BB	<i>L. fragilis</i>	0	1
37.47	BED BB	<i>L. recta</i>	0	1
37.47	BED BB	<i>S. ambigua</i>	1	1
37.47	BED BB	<i>S. u. undulatus</i>	0	1
37.47	BED BB	<i>T. verrucosa</i>	0	1
35.01	BED BE	<i>L. cardium</i>	1	0
35.01	BED BE	<i>L. c. complanata</i>	1	0
35.01	BED BE	<i>P. alatus</i>	2	0
32.91	BED CT	<i>A. g. form corpulenta</i>	6	0
32.91	BED CT	<i>A. suborbiculata</i>	0	1
32.91	BED CT	<i>T. parvus</i>	2	0
32.89	BED BH	<i>L. cardium</i>	0	1
32.89	BED BH	<i>L. fragilis</i>	0	1
31.07	BED BK2	<i>F. flava</i>	0	1
31.07	BED BK2	<i>L. siliquioidea</i>	0	3
31.07	BED BK2	<i>L. cardium</i>	2	3
31.07	BED BK2	<i>L. fragilis</i>	1	0
31.07	BED BK2	<i>P. sintoxia</i>	0	1
31.07	BED BK2	<i>T. verrucosa</i>	0	1
30.3	BED BM	<i>F. flava</i>	1	0
30.3	BED BM	<i>L. siliquioidea</i>	1	0
30.3	BED BM	<i>L. fragilis</i>	3	0
30.3	BED BM	<i>L. recta</i>	0	1
22.46	none	<i>A. g. form corpulenta</i>	0	1
22.46	none	<i>L. siliquioidea</i>	5	0
22.46	none	<i>L. cardium</i>	1	0
18.61	BED BW	<i>L. siliquioidea</i>	0	1
18.61	BED BW	<i>L. fragilis</i>	4	2
18.61	BED BW	<i>P. alatus</i>	1	0
18.61	BED BW	<i>S. ambigua</i>	1	1
17.4	BED BX	<i>A. l. carinata</i>	1	0
17.4	BED BX	<i>A. marginata</i>	1	0
17.4	BED BX	<i>A. g. form corpulenta</i>	2	0

17.4	BED BX	<i>F. flava</i>	17	12
17.4	BED BX	<i>L. siliquoidea</i>	10	13
17.4	BED BX	<i>L. cardium</i>	35	14
17.4	BED BX	<i>L. c. complanata</i>	14	7
17.4	BED BX	<i>L. compressa</i>	0	1
17.4	BED BX	<i>L. fragilis</i>	51	42
17.4	BED BX	<i>L. recta</i>	8	6
17.4	BED BX	<i>P. sintoxia</i>	11	11
17.4	BED BX	<i>P. alatus</i>	5	3
17.4	BED BX	<i>Q. quadrula</i>	1	0
17.4	BED BX	<i>S. ambigua</i>	98	11
17.4	BED BX	<i>T. parvus</i>	0	1
17.4	BED BX	<i>T. verrucosa</i>	81	17
17.4	BED BX	<i>T. donaciformis</i>	1	0
17.4	BED BX	<i>T. truncata</i>	3	1
17.1	BED BY	<i>F. flava</i>	0	5
17.1	BED BY	<i>L. siliquoidea</i>	0	2
17.1	BED BY	<i>L. cardium</i>	0	4
17.1	BED BY	<i>L. c. complanata</i>	0	1
17.1	BED BY	<i>L. compressa</i>	1	0
17.1	BED BY	<i>L. costata</i>	0	1
17.1	BED BY	<i>L. fragilis</i>	1	3
17.1	BED BY	<i>L. recta</i>	1	0
17.1	BED BY	<i>P. alatus</i>	0	1
17.1	BED BY	<i>S. ambigua</i>	11	1
17.1	BED BY	<i>T. verrucosa</i>	0	1
17.1	BED BY	<i>T. truncata</i>	0	1
15.66	BED BZ1	<i>L. siliquoidea</i>	0	1
15.66	BED BZ1	<i>S. ambigua</i>	6	0
15.66	BED BZ3	<i>A. l. carinata</i>	1	0
14.62	BED CA2	<i>S. ambigua</i>	2	1
14.32	BED CB	<i>A. g. form corpulenta</i>	0	4
14.32	BED CB	<i>L. siliquoidea</i>	0	1
14.32	BED CB	<i>L. c. complanata</i>	0	1
14.32	BED CB	<i>L. fragilis</i>	0	1
14.31	BED CB	<i>A. p. plicata</i>	1	3
14.31	BED CB	<i>A. g. form corpulenta</i>	24	22
14.31	BED CB	<i>F. flava</i>	2	0
14.31	BED CB	<i>L. siliquoidea</i>	4	6
14.31	BED CB	<i>L. cardium</i>	0	1
14.31	BED CB	<i>L. c. complanata</i>	3	3
14.31	BED CB	<i>L. recta</i>	0	1
14.31	BED CB	<i>T. parvus</i>	1	0
14.2	BED CB	<i>A. g. form corpulenta</i>	0	1
14.2	BED CB	<i>L. cardium</i>	0	4
14.2	BED CB	<i>L. fragilis</i>	1	2

14.2	BED CB	<i>L. recta</i>	1	1
14.2	BED CB	<i>S. ambigua</i>	10	0
14.2	BED CB	<i>T. verrucosa</i>	1	0
12.6	none	<i>A. g. form corpulenta</i>	8	4
12.6	none	<i>L. c. complanata</i>	0	1
12.6	none	<i>T. parvus</i>	1	0
12.29	BED CC	<i>L. siliquoidea</i>	0	2
12.29	BED CC	<i>L. cardium</i>	2	2
12.29	BED CC	<i>L. c. complanata</i>	1	0
12.29	BED CC	<i>L. fragilis</i>	10	4
12.29	BED CC	<i>L. recta</i>	2	1
12.29	BED CC	<i>S. ambigua</i>	32	2
9.84	BED CD1	<i>A. l. carinata</i>	1	0
9.84	BED CD1	<i>F. flava</i>	1	0
9.84	BED CD1	<i>L. cardium</i>	8	1
9.84	BED CD1	<i>L. c. complanata</i>	2	0
9.84	BED CD1	<i>L. fragilis</i>	4	0
9.84	BED CD1	<i>L. recta</i>	2	0
9.84	BED CD1	<i>P. sintoxia</i>	5	0
9.84	BED CD1	<i>P. alatus</i>	1	0
9.84	BED CD1	<i>T. verrucosa</i>	49	2
9.84	BED CD1	<i>T. truncata</i>	2	0
8.73	BED CE	<i>L. cardium</i>	2	0
8.73	BED CE	<i>L. fragilis</i>	1	0
8.28	BED CF1	<i>E. lineolata</i>	1	0
8.28	BED CF1	<i>L. cardium</i>	5	0
8.28	BED CF1	<i>L. c. complanata</i>	2	1
8.28	BED CF1	<i>L. fragilis</i>	12	2
8.28	BED CF1	<i>L. recta</i>	6	0
8.28	BED CF1	<i>P. sintoxia</i>	1	0
8.28	BED CF1	<i>P. alatus</i>	2	0
8.28	BED CF1	<i>T. verrucosa</i>	19	0
8.28	BED CF1	<i>T. truncata</i>	0	1
7.58	none	<i>A. g. form corpulenta</i>	0	1
7.58	none	<i>F. flava</i>	0	1
7.58	none	<i>L. siliquoidea</i>	0	1
7.58	none	<i>L. cardium</i>	0	1
7.58	none	<i>L. c. complanata</i>	0	1
7.58	none	<i>P. alatus</i>	0	1
7.58	none	<i>Q. pustulosa pustulosa</i>	0	1
7.58	none	<i>T. verrucosa</i>	0	1
7.58	none	<i>T. truncata</i>	0	1